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[illegible]

(Continued from page 5)

pence, Syracuse Hotel, Aiken, S.C.
 May 22-24—National Teleworking Confer-
 ence, Sheraton Towers Hotel, Chicago, Ill.
 May 24-26—National Conference on the
 Global Communications, Institute of the
 8th Engineers, Hotel Sherman, Chicago
 May 27-31—Quality Circle Conference, Sheraton
 Hotel, Chicago, Ill.
 Support Equipment Committee Con-
 ference (Hotel Alton), Mexico City
 June 1-4—National Conference on
 and Aerospace Supervision, Washington
 May 28-29—Pier National Conference, Sheraton
 NARA, Tulsa, Chicago, Ill.
 June 2-5—Soc. Sci. Res. Conf., Phoenix
 May 26-June 5-24th World International
 Conference, Sheraton Hotel, Phoenix
 May 27-30—10th Annual Wright Memorial
 Clubs Meet, Young Society of Dallas, Tex.
 May 31-June 3—University of Michigan
 Seventh Annual Radar Symposium, Ann
 Arbor, Mich.
 June 2-3—10th National Maintenance and
 Operations Meeting, Reading Institute
 School Inc., Reading, Pa.
 June 3-4—1978 IEEE Meeting, Meeting
 Society of the Aerospace Sciences and
 Systems, Ricketts Society, Anaheim
 June 11-13—1978 Meeting, Aviation In-
 formation and Manufacturing Inst. The
 Westwood Atlantic City, N. J.
 June 14-15—1978 Meeting, Institute of
 Engineering and Production, Inst.
 of Radio Engineers, Sheraton Hotel
 June 15-19—Space Flight and Reentry
 Symposium, Symposium, International
 Symposium, Publications, International
 Symposium, Publications, International
 June 22-25—Eight Annual Symposium on
 Computers and Data Processing, Devel-
 opment, Computer, Etc., Lodges, Phila-
 delphia, Pa.
 June 26-28—Fifth National Conference on
 Management, Sheraton Hotel, Tulsa
 June 29-30—Special Technical Conference
 American Institute of Electrical and
 Electronic Engineers, Sheraton Hotel
 June 30—Joint Automatic Control Con-
 ference, University of Colorado, Boulder
 Colo.
 July 1-5—1978 Meeting, Institute
 of Navigation, Wolkstein Inst. W.I.
 July 5-8—1978 International Trade Fair
 Exhibition, McCormick
 American Express Center, Chicago, Ill.
 Aug. 22-26—Wichita District Show and
 Conference, Sheraton Hotel, Wichita
 Sept. 4-10—1978 Flying Display and Exhibi-
 tion, Society of British Aircraft Construc-
 tion, Farnborough, England
 Sept. 10-13—1978 Symposium on Space
 Technology and Telecommunications, Institute
 of Radio Engineers, University of New
 South Wales, Australia
 Sept. 16-17—National Conference National
 Aeronautics, Inc., Washington, N.C.
 Oct. 27-28—International Symposium

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Hamman, D. H.



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The use of two floated two-degree-of-freedom gyros simplifies the inertial platform, provides higher accuracy and reduced size and weight. Selecting two two-degree-of-freedom gyros as compared to three single-degree-of-freedom gyros was found to increase the accuracy by taking advantage of the larger available gyro per gyro and to eliminate the undesirable modulation drift inherent in the single-degree-of-freedom gyro platform. It also provided for tighter packaging and simplified design, which contributes to the total platform accuracy, yet permits considerable reduction in size and weight.



To achieve the development of the Litton platform, considerable had to be given to various new concepts to inertial components, design, packaging, production and testing techniques. Litton developed a unique two-degree-of-freedom gyro measuring three inches in diameter, two inches in length, and weighing only two pounds. This provides a random drift rate capability of less than 0.01 degrees per hour. The two gyroscopes used are packaged in a "dumbbell" configuration which is retained in a four-axis gimbal mechanism. This permits unrestrained capable maneuverability of the vehicle without becoming platform gimbal-lock.



Another Litton developed component contributing to the design of the platform is a sensitive accelerometer featuring a pendulous torque-balance mechanism. The accelerometer functions by means of external electronic integrating circuitry, thus eliminating the complexity and larger size of internal integrating devices. The use of integrating accelerometers contributes to the compactness and light weight of the platform. The accelerometer measures only 1.00 x 1.125 x 1.50 inches and weighs 7 ounces.

Three identical strategically oriented accelerometers are used. The accelerometers, through stabilization signals received from the

gyroscopes acting on the platform servo, provide simultaneous measurement of vehicle acceleration along three axes.



If you're in the inertial or electronic field, it may be that a few of these points have sparked your imagination, it may be that Litton is the place for you to contribute your ideas to advanced projects. Advancers in the state-of-the-art in all our areas of interest are being up shafts of responsibility for the extremely capable of contribution. For the engineers who want more engineering, less paper work. For the engineers with plans who want to see a job through from concept to product.

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Northrop T-38



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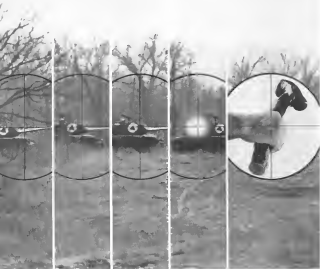
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AERONUTRONIC DIVISION *Ford Motor Company*, DEFENSE PRODUCTS GROUP
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Airlines in Transition

It has become painfully obvious as the airlines speed ahead through the jet age that their most important problem lies in profitably utilizing the vast new seat capacity that the rate and the speed of the jet aircraft has created.

Thus, it is encouraging to note new signs of activity in many sectors aimed at basic broadening of the airline market and at providing large segments of the new growing population of the world with new and compelling reasons to buy airline tickets. The 17-day transatlantic economic fares, Eastern's air bus service experiments, and the relaxation of low fare Florida package provisions of Eastern, National and Northeast are all hopeful signs in the economic road. For it is clear to be hoped for now that the airlines will use some other jet capacity and profit problems by simply competing with each other for a larger share of the current market. Only be honestly broadening the scope of markets they can tap successfully will this problem be truly solved.

There has been a good deal of public discussion regarding the Civil Aeronautics Board's contribution to the problems facing the airlines, and few contributions have been substantial. It is evident now in retrospect that what was a basically sound policy of introducing more competition, particularly on virtual monopoly routes, has been carried too far and that with the advent of large capacity jets, it has created far more competition than is economically supportable or perhaps necessary for growing public convenience.

It is difficult to follow the CAB's logic of recent years that on one hand created a great airline monopoly in the United States and on the other has stubbornly persisted in trying to force Eastern Air Lines into one of the Big Four carriers into a regional operation. The technical and economic impact of the jet age apparently has not yet percolated as far as the CAB and its staff of recent decisions are now indications.

The airline pattern of an increasing domestic and international, requires a basic new approach in light of the technical capability and economic possibilities of jet equipment if the world's airlines are to develop the full potential of this tremendous new contribution in time to achieve their financial health and growth ability.

There are still technical bottlenecks in a lot of economic problems facing any attempt to extend the air travel market to new segments of the population of our country. The jet age has the air traffic control system hanging at the throat. It is now imposing an artificial limit on airline operational capacity as well as introducing a factor of schedule irregularity that cannot help but be discouraging to potential air travelers.

It is perfectly sound to try to plan smoothly for the air traffic environment of a decade hence. But there is also an acute problem of how to utilize the tremendous already installed on the airways and in aircraft and central control. There has been too much emphasis on long range planning—leaving a feasible government game—and not enough push toward more effective and realistic use of the equipment and having also already available.

This is an area where the new Federal Aviation Agency chief N. E. Holtby could apply his talents to good pur-

pose for the immediate future as well as for the "left wing system"—which always appears to be on the left hand horizon but which manages to keep appearing with each passing year.

Along with the new attacks on broadening the airline market, we have a continued an increased attraction by the airlines to the needs and problems of its current passengers. Passenger services took a bad beating in the mid-1960s as growth of airline traffic, producing in recent years an almost constant state of mind in the untrained traveler. The pendulum has begun to swing back, however, and it is interesting to find in almost every aspect of the passenger's contact with his carrier that much more effort is being devoted to making his lot better.

Even when the airlines are confronted with the inevitably available passenger problems imposed by weather and other acts of God, they are once again giving their passengers the impression they really care and the "tough love, Boster" attitude is again fortunately on the wane. Among specific improvements are the increasing number of new terminals where baggage handling about matches the passenger's pace in leaving an aircraft and the many places where it is now possible to board in bad weather without being drenched or frozen.

The local service airlines are continuing to grow at a vigorous pace, topping the billion passenger mile mark for the second straight year in 1969 in addition to recording substantial increases in mail and freight tonnage. With the class rule and more accurate accounting systems, it should be possible to separate the local service carriers' real subsidies and permit their expansion into profitable non-subsidized routes that will set off the trunk carrier's argument in the jet age.

It is obvious that unless the genuine subsidy need of certain local service routes can be precipitated out of their general operating picture, Congress cannot be expected to support overhauling subsidies, and the real growth potential of profitable services will be limited.

The helicopter carriers all jump into the jet age this year, and they should find a major change in the day after and reform of their operations with two jet heli-copters providing the passenger capacity of the DC-7. After long years of bad flight and subsidy support, the large jet helicopter should start these services down the road toward self-sustaining operations and provide the impetus for a major expansion of helicopter service patterns in many large urban areas.

While the airlines are struggling hard to keep their financial books above water, they have increasing efforts to go on as much as at all levels from the federal government to noncompetition to such their order with increasing taxes and higher landing fees. This factor alone could separate any real economic progress the airlines can make during the next year.

This will be another tough year for airlines both economically and operationally, although traffic in all categories will reach new peaks. But hopefully, by the year's end many of the seeds of future economic growth will have sprouted and will be clearly visible above the welter of problems that arise inevitably with the jet age.

—Robert Hott



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Washington Roundup

Key Space Meeting

Critical meeting on the U.S. space program was to take place May 1 at the White House, with chairman of the Senate and House space committees, the Vice President, the head of the civilian space agency, the executive secretary of the space council, and the President's science advisor meeting with President Kennedy. House administrator has held off final action on the space agency's authorization bill for the Fiscal 1962 budget, indicating that more changes can be expected.

National Aeronautics and Space Council apparently is taking a dual approach in responding to President Kennedy's instruction to find ways of speeding Russia in space exploration (see p. 28). In addition to its search for ways to increase the speed U.S. had in such areas as weather observation and communications, it is heavily seeking space "spectacles"—something the previous Administration shied from in public attitude and something President Kennedy initially showed a cautious regard.

Significant legislation that asks Vice President Lyndon Johnson head of the council, the President last week has no doubt that he believes a critical status. He called the bill "a key step toward making the U.S. into its proper place in the space race." The term "space race" has provoked more argument since October 1957 than almost any other single aspect of the space effort.

Series of the nation's progress on military and commercial communications satellites has been completed by the Office of Defense Research and Engineering at the request of Defense Secretary Robert McNamara. It is understood to confirm American's report (AW Apr. 17, p. 33) that the lack of a clear-cut national policy and a single well-defined, broad-based of military and commercial development of a commercial satellite system, which the Defense Department needs for various communications.

Meanwhile, the House space committee has postponed its hearings on commercial communications satellite policy and progress of last said last week. Federal Communications Commission has asked for a still further postponement until it receives certain comments on its recent inquiry (AW Apr. 10, p. 36), but the committee is not expected to grant this request.

Rover in Limelight

Rover nuclear rocket program is the object of more attention than it has had since its initiation. In spite of its predictions from some congressmen that current actions may be aimed at killing the project, statements by President Kennedy and speculation surrounding the activities of various industrial and political-industrial steering group seem to indicate that Rover will be overhauled.

Space task group headed by Presidential Science Advisor Jerome B. Wiesner seemed a hopeful but very cautious note about Rover's progress three months ago. A group appointed by Wiesner now is looking over the entire project. So is the National Aeronautics and Space Council, but a probable will state any recommendations it makes on the Wiesner group's findings. National Aeronautics and Space Administration's technical people also are making their own survey.

The House space committee will report this week on its Rover hearings as well as on its inquiry into the Defense Department's desire to give Air Force most of the responsibility for space payload development. Chairman Charles Stenholm gave a preview of the Rover findings last week when he called on the Administration to give nuclear rocket development top national priority along with the Saturn booster and the Mars crew manned space flight program. He said he based his confidence on the hearings and a staff investigation.

Protest Lacking

Congressional silence on the Kennedy Administration's move to give RLM, the Dutch office, a rocket into Los Angeles is causing concern in the rocket industry. Congress generally has asked for the action to what the current call the "U.S. go-away policy" in greeting critics to foreign carriers. As President John F. Kennedy said in his message to Congress to give over "to not expressed adequately."

USAF Chief of Staff Gen. Thomas D. White says Army will be given the deciding role in selection of an aircraft for immediate buildup of USAF's close-support capabilities. Army is believed to favor the Navy-Douglas A-1H.

Gen. White and Army Chief of Staff George H. DeSobry have agreed on a proposal to submit defense as well as new equipment for defense and to accept them with an effort of the Army's choice. A joint study of the program is now under way.

President Kennedy last week prepared an executive order and an Executive Order's Standards Act aimed at streamlining modified federal state as regulations. He called for "unwavering integrity, absolute impartiality and complete devotion to the public interest" from public officials.

—Washington Staff

Traffic Trends Threaten Airline Profits

Business resumes growth in March, but 1961 deficit may result from first quarter slump, coach gains.

By L. L. Doty

Washington—First quarter traffic slump, coupled with sharp declines in high revenue-yield first class business, now suggests that the transline industry may be headed for a deficit this year.

Although traffic volume bounced its upward trend in March, following a four-month period of steady declines, most industry officials are looking at the immediate future cautiously and with a trace of pessimism, particularly in view of the revamped route structure under which the industry will operate beginning in mid-June (AW Apr. 17, p. 40).

Chief cause for concern is continuing evidence that the expanding population of coach travel is eroding domestic first class traffic without creating new markets (see p. 38). Big question is what effect the Capital United merger, set to effective June 1, and the new transcontinental services by Delta and National, set to effective June 11, will have upon the redistribution of traffic among individual carriers.

It is now generally accepted by the Civil Aeronautics Board that these route adjustments will be watched closely and that further readjustments will be made if the industry in three years is a dangerous imbalance with respect to each carrier's share of traffic.

Individual Progress

That a proper evaluation of the transline industry cannot fairly be based on an analysis of the industry as a whole, but it can explore the relative comparative progress of each carrier thus far this year. Because the

flight engineers' without spare air trafficmen in February distorted normal traffic figures, the traffic figures for that month cannot properly be used to determine individual carrier trends.

The aftermath of the weekend expansion into the first day of March, but generally, traffic activities returned to a normal level sufficiently early to use that month as some measure of the comparative success of each carrier. Specifically, traffic statistics for the month point up the comparative growth of individual coach services within the industry.

During March, the 13 transline carriers reported a 34% increase in revenue passenger miles over the same month last year. Coach seats accounted for 52.9% of total traffic, compared with 48.7% in March, 1960. Delta leads, with 18.6% of the total traffic, down a 0.9% decrease in first class traffic, a 32.9% increase in coach traffic.

United, once a vigorous opponent of

high density coach seating, because the largest domestic carrier of coach traffic in March, moving from the third place position it held in the same month last year. The airline reported a 66% increase in coach traffic, compared with a 24% gain for American, 15% for Eastern and 15% for TWA. United was a leader in the successful effort to increase coach fares last year.

United Leads Industry

United was second to American in the volume of first class revenue passenger miles generated during the month, but it led the coach domestic industry in total revenue passenger miles handled. United moved 57% ahead of the volume carried in March, 1960, while American's volume rose only 8.7%, Eastern 1% and TWA 1%.

Impact of United's jet fleet on its revenue is reflected in the 57% increase in coach available seat miles, and the 14% increase in first class available seat miles. American, Eastern and TWA, presumably guided by the trend toward coach, cut first class available seat miles in March by 15%, 21%, and 11%, respectively.

Northeast Airlines led the industry in traffic gains. Total revenue passenger miles climbed 68% in March, compared with the same month last year. First class revenue passenger miles for the carrier rose 35%, followed by Delta with a 36% increase in the category of traffic. Northeast's coach revenue passenger miles climbed 40%, but Cape Fear, which had a 13% decline in first class traffic, experienced a 59% increase in coach traffic. In this traffic



Convair Studies Additional Nuclear Weapons for B-58

Convair has given Convair's 13 studies to study feasibility of carrying five small nuclear weapons in addition to its long suggested payload. Rep. Joe Wright (D-Tx.), reporting the House Armed Services Committee to get military and Defense Department April 1962 budget for nuclear weapons, and addition of these items would increase \$150 million paid to 14 weapons. Contract covers modification of the B-58's three doors, location of three hydrogen bomb doors. Three flights have been made so far. Wright said his committee has no opinion on the cost, with this load, before any possible of less than \$100 million. Wright said development plan for five conventional weapons had cost \$10 million but a third wing could cost to length for about \$50 million more. He said cost goes after the first 300 aircraft would be less than that for the Boeing B-42. Purchase of B-58 through Fiscal 1964 is 97 aircraft.

also, it was followed closely, by Capital United's worst partner, with a 41% coach traffic gain. Capital's first class traffic fell 5%.

March's first class traffic dropped 11.6% while coach traffic for the month rose 34.9%. Revenue returned in entirety with a 19% net in first class available seat miles and 0.1% increase in coach available seat miles. National led March total available seat miles 34% from the March 1960 level.

Best load factors reported for the month were 62% for National and 60.5% for United. Eastern, last to have a 57.17%, a 1.7 point increase from the industry last factor in March 1960. During March the industry had better load factors each month except in April when a 6.6 point gain was registered.

Available seat miles, or seat capacity offered by the airlines, fell 1% because the week-end which began early in 1971 when jet transports first came in to service. First and only decline in avail-

able seat miles during the past two years occurred in February during the flight engineers' walkout.

First class traffic, industry load factor in March was 44.7%, compared with 54.1% the previous March. Coach load factor for the industry was 88.9%, a gain over the 88.3% for March, 1960. National led the industry with a 68% coach load factor. Delta reported a 67.1% load factor. United 66.1%. Delta posted the 60% mark in the first class category with a 61.6% load factor. Coast controllers were Capital with a 58.9% first class load factor and Delta with a 57.9% load factor.

In 1960, coach traffic accounted for 49.2% of all traffic carried, compared with 53.0% in 1959. Last January, coach service was 52.9% of all traffic, compared with 44% in the same 1960 month, and in February it was 51.6% of all traffic compared with 45.7% in the same month last year.

During 1960, no transline—Eastern, TWA, United, National, Northeast

and Northwest—carried more coach traffic than they did first class traffic. Four others—American, Eastern, Capital and Western—reported coach revenue passenger miles in excess of 40% of all traffic. Coach traffic of United and Capital during the year accounted for 33% and 27% respectively of all traffic carried by each airline.

United led the industry in 1960 in the revenue of coach traffic. The carrier carried on coach revenue passenger miles in 112% during the year. Continental was second with a 79% increase, American third with a 74% increase. United fourth with 35%.

During the first quarter of 1961, coach represented 52.7% of all traffic for the 12 translines compared with 44.7% in the first quarter of 1960. The airlines generated 8.3 billion passenger miles during the first three months, a drop of 8.7% from the first quarter last year. Available seat miles for the transline during the period were 11.3 billion, a 1% decrease from last year.

Growth Of Coach Traffic Domestic Transline Carriers 1959-1960

(in millions)

	Real Coach Revenue Pass. Miles	Coach Rev. Seat	Coach Revenue Pass. Miles	Coach Rev. Seat	Real Coach Revenue Pass. Miles	Coach Rev. Seat	Coach Revenue Pass. Miles	Coach Rev. Seat	Coach Revenue Pass. Miles	Coach Rev. Seat	Coach Revenue Pass. Miles	Coach Rev. Seat	Coach Revenue Pass. Miles	Coach Rev. Seat
	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960
All Five Carriers (See Page 1)	1,270	14,322	7.7	10,347	8,560	17.1	11,855	13,647	-1.2	12,637	15,163	34.3	31.7	40.4
	1,076	11,991	6.9	9,101	7,560	16.1	10,014	11,568	6	10,014	11,568	29.8	28.2	40.4
American	5,439	1,156	9.1	9,990	1,156	16.5	2,574	2,574	9.9	2,574	2,574	40.4	44.7	37.1
Eastern	790	779	9	749	749	10.7	1,151	1,151	9.9	1,151	1,151	38.1	38.1	37.1
Capital	1,361	3,261	-11.1	336	207	19.0	1,001	2,327	-9.1	761	208	38.1	32.2	38.1
Continental	479	461	8	471	471	10.6	1,091	1,091	17.9	1,091	1,091	40.4	40.4	38.1
Northwest	1,027	1,011	11.7	1,011	1,011	10.8	1,011	1,011	12.1	1,011	1,011	40.4	40.4	38.1
Western	1,009	1,009	11.5	1,009	1,009	11.5	1,009	1,009	-17.7	1,009	1,009	40.4	40.4	38.1
Midwest	1,011	1,011	-11.1	1,011	1,011	11.1	1,011	1,011	-11.1	1,011	1,011	40.4	40.4	38.1
United	671	201	10.2	309	201	1.3	429	429	16.4	429	429	40.4	40.4	38.1
Northwest	328	317	-1.7	328	317	1.4	1,011	1,011	1.4	1,011	1,011	40.4	40.4	38.1
Midwest	1,011	1,011	1.4	1,011	1,011	1.4	1,011	1,011	1.4	1,011	1,011	40.4	40.4	38.1
United	1,011	1,011	-1.7	1,011	1,011	1.7	1,011	1,011	1.7	1,011	1,011	40.4	40.4	38.1
Western	220	241	-7.7	220	241	11.3	1,011	1,011	6	1,011	1,011	40.4	40.4	38.1
Total Transline	14,460	13,400	-4.4	14,460	13,400	11.3	14,460	13,400	-4.4	14,460	13,400	40.4	40.4	38.1

Confusion Hampered Military Aid in Cuba

By Larry Woods

Washington—Bitter concerns of military men, contrasted with similar approvals by high Administration officials, muddled the aftermath last week of the shrewd but ill-timed aid to Cuba which was announced and delivered by the U. S. government Central Intelligence Agency.

The Joint Chiefs of Staff, which a year ago had called such an approach feasible with proper military support, had since been adamantly opposed to the closely laid plans for the operation.

Not until plans developed two weeks ago, when the mission appeared to be going badly, were defense officials told to provide support, and then in such a manner that critics and their own members could not be blamed publicly to what they could and could not do to assist the effort.

CIA Probe

In the aftermath of the unsuccessful venture into clandestine aid operations, President John F. Kennedy appointed retired Army Gen. Maxwell D. Taylor to conduct a government-wide probe of the country's ability to conduct such operations. The move himself set off immediate congressional investigations.

Of the approximately 1,900 men in Cuban rebel force which made the landings, approximately a third were experienced, a third more experienced and a third trained previously already operating in Cuba.

In a mix of "background" and "off-the-record" accounts with the press, the government's official position revealed that there has been sharp disagreement since the January change of administration over conducting the Cuban operation. These officials appeared to be generally opposed, but there were indications of a lack of absolute doctrine on participation in guerrilla, or pro-military, operations.

Episode of Confusion

These facts have emerged from the confusion that still surrounds the episode.

- What was to have been only a military mission for guerrilla already fighting in the Cuban countryside and a lot of defense strength on the Cuban mainland was turned into a full-scale "warfare" by anti-communist publicity concerning the strength of the rebel effort.
- As an aid to the Havana rebels during the landings, several Premier Fidel Castro of the planned landings

and permitted him to coordinate and otherwise prepare for action. In a later briefing, he said that he could not understand after the mission was started the same time as the aid and instead of going him time for preparation.

• An airborne support of the landings would have been sent on B-26s was shot down. This remaining B-26 aircraft shot. The area of landing, action, a straggled about 90 mi southeast of Havana, had been the scene of public works which resulted in a good supply capable of taking the Bataan-built tanks of the Cuban Army. A single tank in each of the main force units would have been enough to provide the tanks.

• Despite reports to the contrary, no Soviet-built MIG fighters were reported in the Cuban forces. Only one aircraft available was Lockheed T-33 single engine. Instead, with one jet, British-built Sea Fury naval aircraft. Three of the T-33s were primarily responsible for the crashes and damage to the main force.

• An estimate of the will of the Cuban people to resist as revealed to be pessimistic in order. Neither is the case, as in the real world, are there any real reasons to doubt Cuban, probably because of political security reasons.

• The term "personality operations" has suddenly been thrust on the matter.

Zoo Target Contract

Los Angeles—Contract will be awarded soon for special anti-ICBM test cases to be held in targets in aid of America's Zoo with ICBM. The deal, from Washington, Commission for the Air Force, Defense Science Division, was last reported to total about \$20 million, include Chrysler, General Electric, and so on.

Target testing vehicles will be fired by Strategic Air Command from Vandenberg AFB, Calif., to be intercepted by Nike-Zeus test vehicles from Kennedy. Tests are scheduled to start in late this year. Data ICBMs also will be used as launch vehicles later in the program.

Under the Army Air Force agreement, the Nike-Zeus test vehicles have been used to intercept types but will be actively complicated targets. The country values that will progress to the operational type required for missile interception. This would mean down will be used toward the end of the test series.

service, who had in the great part had relatively little to do with clandestine military activities.

Investigating Group

Analysing Gen Taylor in the matter of intelligence and pro-military capability will be Attorney General Robert F. Kennedy, Central Intelligence Director Alvin Dulles and Chief of Naval Operations Adm. Arleigh Burke.

In appointing the former Army Chief of Staff, President Kennedy said that the country has made it learn from the events contained, with Cuba and that so many "moment and losses, and failures and misadventures" to intensify the struggle against Communism.

Robert Kennedy has had experience in the field of operations against Communism as former chief counsel of the Senate Government Operations Committee.

Former members indicted Adm. Burke was appointed because defense officials and the President have been impressed with the objective of his efforts and his campaign for objective analysis of the situation in Cuba in strategic targeting (AW Jun 30, p. 21).

Regardless of what recommendations Gen Taylor gives the President and the committee, on position as to Congress, the Cuban incident revived discussion of the need for a congressional watchdog, sometime for CIA but has since repeatedly during the 14 years since the agency was organized.

Sponsoring Functions

Former Vice President Richard Nixon, who was the first to visit Cuba with the President, reportedly told the CIA should divide its responsibilities, separating its gathering of information from its operations.

An opponent of the rebel forces first consisted of a unit by B-26s from outside Cuba on an airfield where it was reported that Soviet-built MIG fighters were being uncrated and assembled.

Two days later, this unit was shot down in an attempt at bombing raids. An over for the rebel aircraft was a battle against operations. The Joint Chiefs of Staff were instructed early days later to provide fighter aircraft to cover the bomber operations. Policy guidance for these operations was to indicate and direct to target that Air Force and Navy commanders could not have plans on where, when, or where they would shoot.

An over was also supposed to be provided for the mission force, which consisted of about eight fighters and

was not on flight. However lack of guidance provided effective aid for the mission force. When some of the fighters were downed back to the U. S. Navy, Air Force, and Defense agencies failed to receive operations.

Reaction among military officials was that if they had been provided in time, they could have saved more aircraft, support for the operations.

Defense Department believes in constant of regular military forces in possible operations in another country. It says that "which will have to be studied at length from legal, political and diplomatic standpoints."

By Ford Eastman

Washington—Sixty recommendations of national space goals in an apparent effort to fix a clear, long-term, and right-left focus in some specific space achievements has been ordered by President Kennedy.

The new look at the space program was ordered following the nation's full ordering of a new space and strong congressional urging that the U. S. space program be accelerated.

At the same time, the President said, the nation's full view of the national space act and program that Vice President Lyndon Johnson became chairman of the National Aeronautics and Space Council. The council is charged with making the new strategy and reporting back to the President "in time if possible" to be free of the two to three weeks.

One of the main points was that a re-examination of policy will be made in the development of the new strategy, the President said in a press conference today. A document will be made available to the public, which will be a chemical or nuclear rockets taking us to the moon and which approach when the U. S. is the best positioned in meeting its power requirements in the future.

Kennedy View of Space

The President said that additional funds had been needed to accelerate the program, but that "regardless of how much money we spend on it, we are still going to be second . . . The question is whether the nation's rocket is on a level that is equal to the Soviet Union, or whether the nation's rocket is on a level that is equal to the Soviet Union, or whether the nation's rocket is on a level that is equal to the Soviet Union."

He said that "we have to consider whether this is an program that is a decided success, submitted by NASA to the House space committee at the request of Chairman Brooks, the budget approved on May 16, 1961, \$1,399,613,836. On May 17, 1961,

President Dwight D. Eisenhower for Vice President Nixon, New York Governor Nelson Rockefeller and for President John F. Kennedy. Secretary of the Interior Stewart L. Udall broke the news with a statement in a television interview that the operation was approved and planned by the Executive Administration. President Kennedy somewhat disavowed such a statement by saying that he was fully responsible for all decisions made by his office, and so was fully cognizant of planned operations before that.

Immediate reaction to the failure of the operation was one of disappointment and criticism from the Administration and White House. President Kennedy said that

delays of other programs and still may be successful. "Now I don't want to start spending the kind of money that I am talking about without having a clear, long-term, and right-left focus in some specific space achievements has been ordered by President Kennedy."

The new look at the space program was ordered following the nation's full ordering of a new space and strong congressional urging that the U. S. space program be accelerated.

Saying the space act amendments, the President said "Executive at this instance is evidence of my government's intention to rapidly, leadership and determination to achieve a new space program. Working with the Vice President, I intend that America's space effort shall provide the leading resources, and determination to achieve a new space program. Working with the Vice President, I intend that America's space effort shall provide the leading resources, and determination to achieve a new space program."

This approach reflects a change in the strategy that provided in March 1961 of the national space act and program that Vice President Lyndon Johnson became chairman of the National Aeronautics and Space Administration over the 51 billions reported in the President's budget for fiscal 1962.

CIA Briefing

Allen W. Dulles, director of the Central Intelligence Agency, and Dr. Herbert Gold, CIA official, held the House space committee last week in a closed briefing that was little different than the previous one in a room in the White House.

Chairman Otis Brooks (D-La.) said at the end of the briefing that he had shared but had made the one overall brief and that the briefing had not changed the situation. He said that he had not heard of any new conditions, although some of the House methods he had been briefed on were new.

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TANDEM ducted-propeller transport conceived by Bell Aerospace illustrates the concept Bell and Lockheed Aircraft Corp. are pursuing in the advanced transport competition. Douglas also is interested in proposing a tandem configuration.

10 Bidders Seek Tri-Service Contract

Six of the ten companies submitting proposals for the tri-service transport plan choose either ducted propellers or tilt wing configurations to meet the divergent requirements of speed, maneuverability and cruise duct agencies.

Design proposals went to the Department of Defense early last month and cost and manufacturing proposals were submitted at mid-month.

At least two proposals—one of the two alternate configurations submitted by Douglas Aircraft Co. and one by Bell Aerospace Co. and Lockheed Aircraft Corp.—involve a canard ducted fan concept. This is considered to be a tandem wing variant with engine propellers situated at each of the two wingtips.

At least four others, Grumman Kaman, McDonnell-Canada, Boeing Vertol and Boeing Vertol/Ryan Helicopters, make some form of tilt wing, with either a conventional propeller, or a fully articulated rotor propeller, and with various types of landing or takeoff edge flaps.

Because of the aircraft's function to serve airports as an aerial, the wing span can be short, thereby eliminating the need for wing folding to meet the carrier requirement.

Douglas has purchased the Hawk Model 36 test and engineering data and

leased two key Dowd engineers. The Hawk method (AVF June 5, 1978, p. 34), now owned by the National Aeronautics and Space Administration, uses lifting ducted fans at the tips of a conventional wing and reaction control for hovering.

Tandem Configurations

Tandem configurations need no separate control surfaces for VTOL flight, but various forms of flaps will be used to meet conventional propellers, including rotorcraft propellers, tail rotor or small gas generators in the tail.

Flapless will be better to gain more volume within the confined dimensions of the specifications (AVF Feb. 27, p. 31). The Chance Vought Ryan-Hiller proposal can be typical. Makeup of this design—designated V-47—shows use of a high-wing, a cockpit with good visibility with the eyes in high seats looking over a short fuselage, and rear landing with air integral downwash winging wings.

Though Chance Vought has experienced with a design from Ryan-Hiller, McDonnell-Kaman's ducted fan called ADAM (for deltaform and modularized), the proposal does not use this particular propulsive element.

Boeing Vertol and Boeing Vertol/Ryan Helicopters submitted proposals. The Vertol

proposal was in cooperation with Boeing's Transport Division and is based on experience of Vertol's work with its Model 78 tilt wing test bed. The Vertol proposal reportedly is highly sophisticated and involves a variable geometry wing.

Bell Helicopters reportedly has submitted a proposal involving rotary wing possible based on its XV-15 tiltwing test bed. Sikorsky Aircraft's proposal does not involve rotary wing.

Norfolk County Division of General Dynamics and Republic Aviation entered. Doanair, now Republic Aviation entered, but Canada's a subsidiary of General Dynamics, is teamed with McDonnell Aircraft Corp. Grumman Aircraft Engineering Corp. and Kaman Helicopters are holding at a loss, and North American Aviation's Columbia Division also has no entry.

Team Approach

Kaman's previous work on the K-16 tilt wing and flap combination (AVF Jan. 13, p. 121) is probably indicative of the team's approach. Grumman is primarily responsible for the design, and Kaman is contributing in rotorcraft development and other VTOL experience.

McDonnell-Canada also has undertaken to have a tilted flapless wing approach with two conventional propellers

less driven by four General Electric T86 engines. Main propellers were tilted until this engine, which has been developed with Navy funds.

A complete study was done by McDonnell on a conventional helicopter configuration, but it was not submitted in a proposal since this configuration could not approach the speed requirement though it would meet other performance categories.

Some previous work by Bell Aerospace, extending back to 1953 and which led to the design of Bell's Model 1190B tiltwing ducted fan proposal for a USAF advanced aircraft research requirement, SOB-180, also shows some light in its design considerations for the tri-service transport.

Bell has done detail studies on five possible configurations:

- **Tilted untwisted wing.**
- **Tilted flapped wing.** less than 90 degrees.
- **Tilted propeller.**
- **Flap in wing.**
- **Tilted ducted fan.**

The tilted untwisted wing has obvious weight advantages but might have aerodynamic problems in transition. The tilted propeller requires blade folding on load at a certain. Tilt wing looked better for low hovering work, higher speed application. Propellers of tilt wing configurations point to three configurations:

- **Power requirements of a tilt wing configuration are lower in hovering and in low speeds.**
- **Full efficiency of ducted propellers may depend heavily on bank variable geometry taken and evolved.**
- **Intermittent duct between ducts and freedom in duct area configurations may become a problem.**
- **Duct wing could be a tougher problem than using of an untwisted propeller.**

Bell's earlier studies of ducted fan propellers led it to conclude that since the ducted propeller-turboprop engine combination results in a 30-100% increase in thrust over the same untwisted combination, that about 50% of bell

engines having efficiency was obtainable, and that speed capabilities up to 500 mph was possible.

In the years since the studies began in 1953, various VTOL transport and other aircraft were studied.

• **DBRC (nowaday) test aircraft** proposed to Office of Naval Research in 1966 using major components of the General Electric engine. Propellers were two General Electric T55 turbo-prop engines of 6,270 lb. gross and carrying a crew of two. Reaction control at the landing engines were used for pitch and yaw. Airframe located out of the ducted propellers were left for roll control at hover.

• **DB6 observation aircraft** designed to a Navy specification. It also utilized two engines, mounted T55s, had a gross weight of 7,550 lb. top speed of 380 kt. at 5,000 ft.

• **DB6B1 turbine transport** proposed for the USAF transport requirement.

The high wing, twin-engine aircraft also a twin rotatable duct driven in each until after the transition period, gaining only 14,100 lb. VTOL, but the speed and empty configuration—155 kt. at sea level and a VTO speed of 394 mph—was, which can be increased to 1,590 mph wing maximum VTO weight of 17,410 lb., approach the tri-service transport performance objectives.

Propellers are two General Electric T55 1.5 engines mounted in the fuselage. Ducted propellers at the wingtips are represented by a crew of four. Effects in this engine use a variable geometry inlet provided by extendable flap Bell studied in 1946 in an ONR sponsored wind tunnel test program at the University of Wichita. The design increases the number of the chord line better performance at hover.

The airframe is conventional wing structure and fuselage with possible for separate wing. Conventional two wing structure without leading edge flap is also a good. Wind tunnel tests in 1957.

Shaded propellers in each duct conventional and also driven at a maximum 2,400 rpm, reduced loss area.

main engine rpm, at 6,625 through gearing at a center transmission in the fuselage.

• **Lowest Bell studies** for variant engine of V-STOL, transport under Air Force Study Requirement SR-175, will for meeting engines in the duct controls. The combustor must be sufficiently large to use even for turbofan engines. Besides the DB600, three designs include:

• **DB68 medium transport** with six Al-105 550-hp engines mounted in each engine, two engines each in the two wing tip ducts, and a single engine in each of the two sub-duct ducts. The paired engines duct counter-rotating propellers, the reduced single engine duct propellers. A GE 115 turbojet engine in the rear fuselage provides low speed auxiliary power control. Empty weight is 12,440 lb. and VTO gross weight 29,710 lb. Maximum speed is 445 kt. at sea level and VTO speed is 487 mph.

• **DB607 heavy transport** powered by eight Al-105 550-hp engines, two in each of the four ducts. Empty weight is 49,000 lb., and VTO gross weight 120,200 lb. Performance is similar to the DB61, but two DB61s are required for the low speed climb.

Bell has studied the turbine duct configuration for an aircraft transport with the designation DB622.

In a tandem configuration, propellers would be interconnected by engine control mechanisms. Bell studies including such a configuration, with a 28-35 ft. air wing span including ducts, could maintain altitude in horizontal flight using three engines, and hover at three engines, at least weights three times.

Since the propellers in the engine area duct still would be providing thrust through interconnections, Bell considers a 127 ft. induction would be sufficient.

There are however three individual configurations, but Bell believes this factor is offset by the smaller propeller diameter provided by ducts producing higher propeller rpm, and shorter, higher loading gear requirements.



FRONT and rear views of Chance Vought Ryan-Hiller V-47 findings including some details, ducted configuration to meet volume requirements in a relatively small dimensions. Each fuselage will be typical of design submitted in the competition.

Better Bioastronautics Research Urged

By Edward H. Kolos

Chicago-Bioastronautics research capability and accomplishments are increasing, but unless management at all United States programs is consolidated, "I will never catch up with the Russians," according to Brig. Gen. Benjamin A. Stokfield, commandant of the Air Force Systems Command.

Gen. Stokfield told Aviation Week that space medicine research now is being stifled by fragmentation, and he suggested strong single point control and coordination of the multitude of independent research which now exist among government agencies engaged in bioastronautics research.

Stokfield made three points during the 12th meeting of the Aerospace Medical Association, which 316 scientific reports were given last week at three consecutive sessions. Reports covered scientific and clinical studies in pathology, operational medicine, physiology, thermal stress, acceleration, and visual distortions, orientation and radiobiology.

Officials feeling at the meeting concerned by defense industry and Defense Department expenditures on the status quo have urged by the medical professions in space and astronautics research. Stokfield said, "Maximum progress is possible by combining the best of what they get into a broader cooperative research program" unless the diverse phase includes human factors needs.

Col. Karl H. Houghton, chief of the Aerospace Medical Division in the USAF, Saigon, General's office, said that engineers are gradually realizing "we pay our way." Houghton and part of the difference between hardware and medical scientists are becoming dissipated in a growing medical aspect which will be worked further along the disciplines such as common language. Air Force has started a program of coordinating which involves medical specialists active in engineering ahead two years and write a thesis on joint problems.

Houghton also looks for an amalgamation of the life sciences effort because that is a challenge of people to do the work. He said medical scientists are devoting considerable effort to the better programs, but there is a need for better integration.

Stokfield told the Air Force has the ability to provide full support to the total national space program, using complete resources in the country. He said, however, that single strong management is more important than what does the managing.

The increased stature of bioastronautics research was demonstrated in the

great variety of subjects under study and discussed at the Aerospace Medical Association meeting, and by the growing trend to establish and expand the human factors capability in industry. Remaining activity is now at its highest level for experienced life sciences researchers.

Most of the reports delivered at the meeting were on research aspects of manned space flight, a natural difference from past meetings where direct trades dominated.

- Among the significant topics were:
- Space magnetism and the potential hazard of ionized magnetic fields on humans.
- Requirement for more study of the astronaut based on spacecraft.
- Description of a back-seat bladder pilot restraint system which will allow the pilot to control a rocket vehicle under high acceleration.
- Effects of low pressure on skin tissue reperfused by pressure suits.
- Description of the Mach 3 escape capsule designed for the B-70.
- Demonstration of an 800-lb. space suit hidden with enough food to

survive three men in a 14-day mission.

- Recent experiments in the study of metabolic effects of space travel.
- Medical electronics, a rapidly growing field particularly in instrumentation for monitoring humans and animals in space missions.
- Continuing studies in acceleration levels and methods of increasing tolerance to g forces.

The News reported during the session that for the past two years, all air business have been given the opportunity to volunteer for astronaut training. Of 1,310 pilots, 310 volunteered and 24% of the volunteers served as well as the seven Mercury astronauts in selection criteria studies.

The Aerospace Medical Association met May 7-9 in Chicago at the Sheraton Hotel. The meeting had not responded to the invitation late last week. Dr. Dietrich E. Boush of the Naval School of Aerospace Medicine, Pensacola, Fla., reported on the two major effects of magnetic fields in which he concluded that data is too fragmentary to make an uncontradicted forecast. He told Aviation Week that ionospheric density should be observed in the near future as high-altitude, a condition largely unknown. There is a theory that some could be better and larger in magnetic fields stronger than the earth's 0.5 Gauss level. Another or simultaneous of magnetism could have an opposite detrimental effect.

Low fields are known to cause an interplanetary space, where astronauts are about 10⁻¹⁰ Gauss, and on the surface of the moon, where the magnetic field is less than 10⁻¹⁰ Gauss. Man and Venus fields are believed to be similar to that of earth, together in thought to have a strong field, and man may be in intensities from 100 to 14,000 Gauss. Strength in a solar field reaches 100 Gauss. In addition to planetary magnetism, electric propulsion systems will be a source of exposure to high field strengths in manned flight, Dr. Boush said.

More are the largest effects exposed to low magnetic fields, and results have been contradictory. In one test, a mouse was exposed to 5,000 Gauss for four weeks and showed a tendency to raise a scaly appearance with an increased sterility. In another experiment, a group of mice under test died within 10 days when exposed to a field intensity of 5,000 Gauss. Third experimental using two generations of flies showed no variation from normal except for faster movement in the field. Flies were observed how larvae to pupa to fly in two consecutive life cycles.

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AVIATION WEEK, May 1, 1961



Why Air France Jet parts never wear out

This technician is subjecting a gear from the altimeter of an Air France 707 Intercontinental Jet to microscopic study. It's being examined for signs of wear or oxidation... and this is just one of 85 separate tests given every Air France altimeter every 1600 hours of use!

What's more, each Air France jet part undergoes exhaustive inspection... and has a "life" of its own. Technically, this "life" is called the "potential"—a fixed period of time when it just can't wear out. In the case of the altimeter, for instance, the potential is 5,000 hours. Yet Air France in-

spection is continual throughout this time period, and long before the potential is reached, the part has been replaced by a new one!

Such attention to detail explains why 8,828 out of 22,300 employees, almost one-third of all Air France personnel, are engaged in maintenance. Skilled technicians working on a round-the-clock basis guarantee that every Air France flight will leave the ground in perfect working order. One more reason why Air France is the world's largest airline, with a forty-two year record of flying experience and service.

AIR FRANCE JET

World's Largest Airline/Police Personnel Ready To Serve you in New York, Chicago, Los Angeles, Montreal, Mexico City

BEA Orders Three Argosy 650s For European Cargo Transport

London—British European Airways, according to a report last July, declined to order bulk cargo to transport materials has ordered three Argosy 650 turboprop fighters for delivery in November at an undisclosed price.

The new airplanes will supplement BPA's already extensive fleet of cargo aircraft in holds at its Victoria Vanguard, de Havilland Comet and Victor Viscount passenger planes.

The cargo, at present, is in small parcels but BPA says overall capacity has been increasing enough to cover requirements for the larger cargo items. In comparison, its Jumbos (four figures available) BPA carried 1,119 short tons of freight, up 7% over that month a year ago.

In comparison, British Overseas Airways Corp. handled 951 short tons in January, but this was a 27% improvement over January, 1960. Last year BOAC carried a total of 16,717 short tons of freight, a 27% improvement over the preceding year.

Orders of the three Argosy 650s does not mean that BPA is making a marked attempt to develop a new cargo service, spokesman said. Instead, the airline is leaving the responsibility to remain out of the way of a "complete freight service" for the customer who needs an element of heavier duty.

The 650s will be based at London (Dorchester) Airport and will be used in conjunction with BEA's Douglas DC-7s converted for cargo, stripped Vickers V11s and three York-based four-Dash Air Services Ltd.

BEA currently is studying possibilities of using the AW 650s as daylight flights to a number of European ports near. Most bulk freight shipped abroad the present all-cargo planes is flown period at night for packing in touch the following day. The airline hopes to eliminate this delay in scheduling runs which would mean it is ground transportation for later delivery.

Scheduled flight runs will connect London with Paris, Brussels, Nice, Milan, Rome, Düsseldorf, Frankfurt, Amsterdam and Copenhagen as the continent, and Manchester-Clayton and Manchester-Bristol in England.

One reason for selection of the AW 650 BEA noted was that that the airline does not use a member of Rolls Royce DTP engines at London Airport and "This means that the airplanes will fit neatly into the special maintenance schedule."

Another factor is that BEA was involved in design discussions with Air-

wing Warton when the 650 first went on the drawing boards. Although the company was not the creator of the reference in overall design of the Victor Vanguard.

The three planes ordered by BEA will be fitted with a National quick-loading system developed designed by the 650 by Armstrong Warton. Using this method, the aircraft carrier can be loaded in 12 min.

Argosy is fitted with light after roller load in steps on the fuselage floor. This consists of a movable bridge, section which aligns with the track and rollers. The rollers are raised and lowered in locking mechanism. No elaborate ground handling system is needed, the concern added. In all, the 650 will carry eight tons of cargo.

National Advertising Criticized by Board

Washington—Civil Aeronautics Board has ordered National Airlines to avoid "misleading and deceptive" language in the airline's "Fly and Dine" plan for Florida vacationers.

Items of the Board's case and dissent under against National was a complaint that since then a year ago in National Air Lines, which charged that a National advertisement created the public impression that Fly and Dine passengers would receive a complete two-week vacation, including hotel accommodations, one rental car and round-trip fare for \$70.33 plus tax.

Published one time in the New York Journal-American, the advertisement contained no material near the price, although the sum in the cost of round trip, night meals and taxi between New York and Miami on Monday, Tuesday and Wednesday nights was also included. The line quoted in the advertisement was represented as being the last offer in the New York Times market, although Eastern and Northeast South also offer the same prospectively.

Supporting recommendations made earlier by Chairman Curtis C. Henson, the Board ordered the abatement of the advertisement and noted that while it was published only once, it "misleadingly" misled thousands of prospective customers. Both the content and publication of the advertisement "were not authorized, but were covered by the airline to give National a competitive advantage, the Board said today.

CAB Cuts MATS' Rates

Civil Aeronautics Board last week cut the maximum rates Military Air Transport Service can pay for cargo on lines for carrying physical loss of cargo overseas. At the same time CAB has indicated that the adjustment of Military Mail is only temporary further rate cuts in the future. (See story p. 6A.)

The new rates apply primarily to supplemental and domestic cargo services, which must derive CAB approval before flying overseas to points not covered in their operating certificates. In actual practice, however, U. S. R. R. carriers usually report such rates when billing for MATS overseas.

The Board also opened the door for other rate reductions by allowing the same carriers to quote rates based on charter gear such rates reflect that the rates actually lower. But CAB has not decided whether carriers operating short-range transports could bid on the basis of spot rates rather than their own rates could not justify this.

Based on a maximum domestic first-class rate of 18 cents per pound, Continental and Douglas DC-7 aircraft, the new maximum rate for round-trip cargo service in these aircraft is 13.75 cents per ton-mile. CAB rate was 13.5 cents. When this carrier recent prices per ton-mile and cargo in an effort to save rates of 13.5 cents per ton-mile could not justify this.

Commenting on what action it would take if it was not demonstrated a material operator probably at still lower rates, CAB said that consideration based on additional data might warrant further adjustment. But it added that it "should" not generally have a say in a group or class of service on the basis of only one carrier.

Swissair Will Lease Two Convair 440s

Zurich—Convair Division of General Dynamics Corp. will deliver two 440V-72 jet transports to Swissair on a lease basis for this summer to fill the gap left by delivery delays of the long-range 990.

The first 990 will arrive in Switzerland in August, the second in early September. Two will be placed in service on Geneva to Paris routes until the 990s begin operations early next year.

Details of the agreement, which will enable Swissair to match the jet competition of other Air Europe carriers, which it has had in late with Douglas DC-6s, represent the first time three 440s were not announced.

TWA 1961



TWA leads with Jets on time!

TWA's on-time Jet record is the best in the business. For over a year TWA has averaged decidedly better than its two transcontinental competitors, based on latest available data from the Civil Aeronautics Board. Seasoned Jet travelers know that TWA sets the Jet standard in the United States for on-time departure,

on-time arrival...for added reliability TWA is proud of its experienced team of Jet captains, flight and ground crews, maintenance men, meteorologists. Their skill made this extraordinary record possible. Next time you fly for business or pleasure, get there on time...aboard swift, dependable TWA Superjets.

Fly TWA Superjets across the United States and to leading cities in Europe and Asia. Call your travel agent or nearest TWA office.



This TWA Superjet is shown in service and used according to TWA Flight Schedule.

Airlines Measure Religious Tour Market

By Arnold Shuman

New York—Transatlantic carriers are taking a new hard look at the religious air travel market—a niche largely neglected by the high-cost expertise of the carriers' jet fleets.

Air France, playing down claims to "specialize," says a charter means that a religious group must generate enough interest to fill a full flight, a concentration instead on religious fares available on a space-allocated basis. "In that era," as Air France spokesman states, "groups of 10-15 pilgrims can choose between a variety of flights and excursions."

The French carrier currently is conducting a market research program with the religious air market, analyzing the results of previous religious package tours and projecting these figures into a series of potential business deals. One Air France official said, "In French, the word is 'concession.' Consequently, the airline is engaged in an advertising program geared exclusively at the religious market. Over 60 newspapers and magazines with religious overtones carry Air

France advertisements—including over 4 million subscribers and with a total readership estimated at nearly 15 million.

Air France maintains a special segment of its Time Department geared to the religious market. Like most other transatlantic carriers which have under gone the transition from profits to jet competition, the additional jet capacity and the expense of running jetliner equipment has forced Air France into an agreement with a "cooperator" of all its ports of the air transport market.

Tour Increase Seen

In 1960, Air France sold 67 religious tours. This year the airline already has booked 97 tours for the months of June and July and the prospect for September, including last year's record, "are excellent," as Air France spokesmen said. Concerning Air France estimates on short religious tours with "increases of at least 50%" (although another has less cautious estimates put the figure considerably higher on the basis of figures already available to the French airline.

Religious tour interest, according to Air France, is widespread. Groups of pilgrims have gathered from every corner of the United States and Canada. The added religious incentive to travel is probably attributable to a combination of factors. Organized religion is on the ascent throughout the country, the traveling expense of the airline has been around and jet equipment lends itself to comfortable, fast transportation.

For the most part, a religious tour begins in a parish or congregation. A group of people find themselves interested enough in visiting shrines or religious sites to permit the trip and find the purchase of their religious leader contact the airline. If enough of the congregation is interested, then a charter is so called. Most likely, a religious tour is either selected or suggested. No one does this preclude individual travel with a predominantly religious motive. The number of people inquiring for spiritual reasons outside the organized tour program probably outnumbers the tour themselves.

Under Air France's current religious program, an exclusive Madison Ave. is



Preliminary Design of Piaggio-Douglas PD-808 Executive Jet

Aviation's magazine of Piaggio Douglas PD-808 (ATF April 17, p. 99) shows preliminary configuration of light jet business transport which is to enter its first flight in 1962. Preliminary design of the six-passenger, two-engine aircraft set complete at the R1 Research Division of Douglas Aircraft Co. Design engineering and production is to be done by Piaggio of Genoa, Italy. Douglas has a system on engine sales and service rights outside Italy and a few other European countries. The U. S. company also has manufacturing rights in any order for the engine placed by the U. S. government and also produce the engine for commercial customers after Piaggio has sold a specified number. The Italian air force has interest in the airplane and is helping to finance its development. The PD-808 will be designed to cruise at 500 mph and 10,000 ft; with a cruise pressure equivalent to 7,000 ft, altitude.



AIR-WHO?

A year ago, the sight of an Air-India plane at New York's International Airport might have provoked the query, "Air-Who?" or even "Air-Whoo?" Today, 355 million world-wide passenger miles later, over 54,000 transatlantic hours have topped the delights of Air-India's potential passenger service. Now we've expanded our schedule to five flights a week from New York to

London, Paris, Geneva, Frankfurt, Freetown, Rome and the East. And now more travelers than ever can enjoy the warmth of lavish Eastern hospitality . . . the multitude of charming air-cabed hostesses . . . and the comfortable surety of Boeing 707 Red-Rover Jets, piloted by veterans of Air-India's 14 years of world-wide service. Today, any travel agent can tell you

about the success of Air-India's new transatlantic schedule. (And if he should query "Air-Who?" let's be important.)



Air-India, 617 Park Ave., N. Y. - Chicago - Cleveland - Dallas - San Antonio - Indianapolis - Washington, D. C.

Dollars Per Total Aircraft Hour

TYPE	FIVE OPERATORS					SEVEN MAINTENANCE					TOTAL OPERATING EXPENSE	TOTAL FIVE OPERATORS	TOTAL SEVEN MAINTENANCE
	LOW EST. PER HOUR	FUEL OIL LUBRICANTS	NEAR PORT FUEL	OTHER PORT FUEL	TOTAL	LOW EST. PER HOUR	FUEL OIL LUBRICANTS	NEAR PORT FUEL	OTHER PORT FUEL	TOTAL			
707's													
Air-India	1.13	2.50	0.45	0.25	2.33	0.36	0.44	0.44	0.31	1.55	2.01	1.72	1.55
Boeing	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Continental	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Delta	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Eastern	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Northwest	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
United	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Trans World	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Varig	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Other	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
747's													
Air-India	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Boeing	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Continental	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Delta	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Eastern	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Northwest	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
United	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Trans World	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Varig	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55
Other	0.92	2.25	0.25	0.10	3.52	0.30	0.44	0.44	0.31	1.49	1.72	1.55	1.55

Turbine-Powered Aircraft 1960 Operating Expense

(Data supplied by Ray & Ray, Washington, D.C.)

Averages By Type: Cents Per Available Ton Mile

TYPE	Five Operators	Seven Maintenance	Superior and Ranch	Total Estimated Expense
707's	8.00	8.00	8.00	11.18
747's	4.71	5.00	5.14	12.40
707's	4.58	5.47	5.51	10.56
747's	6.50	5.75	6.26	12.54
707's	4.50	4.92	4.77	10.42
747's	6.50	4.20	5.90	12.79
707's	6.75	6.12	5.20	12.42
747's	12.27	6.81	5.64	24.72

Cents Per Revenue Aircraft Mile

TYPE	Five Operators	Seven Maintenance	Superior and Ranch	Total Estimated Expense
707's	11.18	11.18	11.18	11.18
747's	12.40	12.40	12.40	12.40
707's	10.56	10.56	10.56	10.56
747's	12.54	12.54	12.54	12.54
707's	10.42	10.42	10.42	10.42
747's	12.79	12.79	12.79	12.79
707's	12.42	12.42	12.42	12.42
747's	24.72	24.72	24.72	24.72

AIRLINE OBSERVER

► Question whether Alaska, the Irish airline, will be granted Los Angeles night flight rights remains as whether Italy will agree to exchange traffic privileges with the U.S., a condition also proposed by the British as they bid for West Coast rights (AWF Apr. 24, p. 10). Italian originally agreed to the exchange, later revised this decision. Chances are strong that Alaska will now accept this condition in order to get the Los Angeles traffic rights.

► Watch for a move toward diversification outside aviation fields by at least one local service airline as a means of bolstering revenues to cut subsidy needs.

► Convair 990 transport No. 1, with several engine problems, has flown five consecutive days at speeds up to its operational limit of Mach 0.91 without any recurrence of the difficulties which plagued the pilot in his.

► Lockheed predicts that commercial versions of its C-141 military freighter can carry cargo at direct operating costs of about four cents per ton mile, depending on stage lengths and load factors. Comparable costs for Douglas DC-4s equipped are now about 11-12 cents. Test military C-141 is scheduled to become operational in late 1964 or early 1965 (AWF May 20, p. 24).

► Look for revolutionized revenue air carriers within the local service airline industry. Currently, both South Central and Allegheny are actively seeking airport permits.

► Post Office Department realized a net profit of about \$10 million in the current fiscal year on air mail operations. Post Office profit compares with \$1.6 million net earnings for U.S. airlines in 1960 (AWF Apr. 17, p. 40).

► Aeroflot is becoming increasingly cost conscious in its attitude toward flight schedules as additional high capacity turbo-prop aircraft transports go into service. The Russian airline has always been casual about schedules, compared with Western carriers. However, the organization is now cutting for better weather briefings to reduce flight delays and cancellations and for improved ground service handling and facilities to cut late departures.

► Boeing Airplane Co. has selected Sperry Gyroscope to provide back-office flight automatic control system for its 727 three-seat transport, following a competition among major autopilot manufacturers. Collins Radio reportedly was runner-up in the competition.

► Supplemental airlines have asked the Civil Aeronautics Board to set maximum rate standards for transatlantic charter operations in protest against a 5% per Togo Lane proposal to set cross charges in Panamair's fee to the U.S. and return at rate as low as 99¢ per person. Independent Airline Association claims the Togo Lane rate will spell "economic disaster" for the supplemental carriers.

► Civil Aeronautics Board is considering an increase in baggage allowance for women, and has asked domestic airlines for comments on the proposal. Chances are strong that questions of reasonableness and discrimination will block the move.

► International Federation of Air Line Pilots Associations has complained to Trans-Canada Air Lines, Canadian Department of Transport and the U.S. Federal Aviation Agency over operation of the Vietnam-Vancouver helicopter transport with a crew of two pilots. C.N.S. says, the group's proposal called for a dual crew member to operate U.S. Federal regulations. He said the two-pilot crew is inconsistent with the "practice of major air carriers of the world."

► Aeroflot put its Tu-114 176-passenger turboprop transport into scheduled service but with limited service will be conducted twice weekly on the Moscow-Khabarovsk route.

► Air France is operating its Lockheed 1049H all-cargo transports on the New York-Puerto route with a cargo capacity of 33,000 lb.

SHORTLINES

► Aeroflot, the Russian airline, is using television screens at Moscow's Vnukovo and Sheremetyevo airports to provide latest flight information.

► Aeroflot Sud American has Civil Aeronautics Board permission to conduct talks with Western Central and South American cargo aircraft concerning establishment of cargo rates in the Caribbean area.

► American Airlines reports a load factor of 50.0% for its Boeing 730 turboprop aircraft during their first month of operation on the New York-Los Angeles route. Load factor for American's Boeing 707 for the same period and route was 66%.

► British West Indian Airways will begin Boeing 707 service from New York to Barbados and Trinidad on June 16. The weekly flights will leave New York on Saturdays and return on Sundays.

► Continental Airlines will begin operating three round trips a day between Houston and Los Angeles with Boeing 707s on June 11, initiating service on the new route awarded in the Southern Transcontinental Case.

► Delta Air Lines has been awarded a 200-hp turbine between overhead (TBO) engine to 1,200 hp on the General Electric CF70 turboprop engine powerplant for the carrier's Convair 440 fleet.

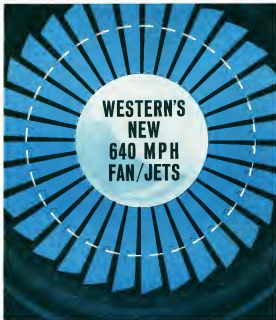
► Japan Air Lines' transport authority to operate flights over its Tokyo-Colombo-Hong Kong route on its Boeing 747 and Singapore has been extended one year by Civil Aeronautics Board—provided that no passengers board for or originate at points beyond Hong Kong land or island of Guam, or island under U.S. control.

► North Central Airlines will begin service on May 1, to Regina, Saskatchewan, Canada with one round trip a day terminating in Minneapolis/St. Paul.

► Northwest Airlines has ordered six Boeing 720B turboprop transports with options on six more. Delivery is to begin June and be completed October.

► Pan American World Airways has begun a low fare freighter service from New York to San Juan, Puerto Rico at \$55 each way.

► Panair Austral, Inc., has declared a 100% stock dividend, the first in its history. The dividend is reported as the third or even paid for a local service airline.



ONLY ON WESTERN ALONG THE PACIFIC COAST

Coming Soon: The Fastest Take-Off, Climb, And Cruise This Side Of Sound

This is it! The ultimate achievement in jet travel... Western's magnificent new Boeing 730-B Fan/Jets! They're the world's fastest, finest-performing jetliners and will soon join Western's ever-expanding Jet Fleet of mighty 707's and superb Electra II's... to bring you the most modern, most comfortable, most complete air service ever offered in the West.

**WESTERN
AIRLINES**

PROGRESS REPORT ON THE WORLD'S MOST EXPERIENCED AIRLINE



Lockheed P-7, Pan American's first plane



Martin 132 the famous "China Clipper"



Douglas DC-3, noted for its versatility

**Pan Am...
1½ billion
miles later**



Pan Am's first flight covered 66 miles between Key West, Florida, and Havana, Cuba. Now, more than a third of a century and some 1½ billion miles later, Pan Am serves 80 countries on all 6 continents. Pan Am Jet Clippers fly to 84 cities around the world, including 16 U.S. Gateway cities. And only Pan Am directly links so many major cities on both sides of the Atlantic by jet. 22 in Europe, 11 in the U.S.

Pan Am Clippers have crossed the Atlantic more than 85,000 times; the Pacific, more than 66,000 times; circumnavigated the world more

than 5,500 times. Pan Am is the one airline that has flown more than 30 million passenger-miles overseas. The best way to sum up these statistics is to say that Pan Am, aside the *Peaceful Endeavor* of *Enterprise* to every flight.

Choose Pan Am and you enjoy the assurance that comes with flying the World's Most Experienced Airline. You relax, knowing that your Pan Am crew has been trained to exceed U.S. standards, that your plane has received expert care and maintenance. From your knowledge of Pan Am's experience comes wonderful peace of mind.

Illustrations by G. F. H. H.



FIRST IN THE ATLANTIC
FIRST IN LATIN AMERICA
FIRST ROUND THE WORLD

WORLD'S MOST
EXPERIENCED
AIRLINE

Fourth N. Y. Airline Airport Disputed

By Glenn Gortner

New York—Despite the Port of New York Authority's campaign, this airport will not end another future airport by 1965, according to a recent study by United Research, Inc.

The lengthy report, which includes national and regional traffic forecasts and discussion of VTOL-VTOL systems, was made for Interlocking Trusts (Inc.), a New Jersey corporation which lies on the site the Port Authority cited in late 1959 as the only possible location for a fourth major airport to serve the New York-New Jersey area.

The Port Authority's so-called "preference" 1959 report stressed up three political resistance and controversy among communities in the area. A "definitive" report for the agency was supposed to follow in about six months, but has not yet appeared. Most recent projected date for its completion is some time next month. The Port Authority had feared that the need for a fourth major airport would become acute by 1965, when La Guardia, Newark and New York International's passenger capacities would be attained.

In preliminary study indicated a proposal for a \$220-million jet field in Vauxhall, N. J. (AW Dec 21, 1959, p. 32).

Research Conclusions

But the United Research study, which gives more weight to the possible use of city center to city center VTOL-VTOL, aircraft and to suppose such is an traffic control, reached the following conclusions:

- Capacity and demand estimates do not show a need for the fourth airport by 1965, and no new airports will be required until 1972.
- Location of general aviation activity in its present location would be the best for the fourth airport.
- Direction of general aviation movement from La Guardia, Newark and Mitchell would give these airports the capacity to handle air traffic until after 1968.
- Position of additional general aviation facilities at airports other than the above three, or at a new airport for general aviation, would provide additional capacity at substantially less cost than would be involved in the construction of a fourth general purpose airport.
- Dislocation of airline flights among four New York area airports instead of the present three would penalize the airlines and airline passengers in terms of cost and convenience.

In order to predict the future volume of traffic the New York airports will be required to handle, the United Research study first forecasts traffic levels on a seasonal basis.

In 1965, the study predicts, U.S. domestic passenger miles will total 41.9 billion. By 1980, the total will reach 56.6 billion. Volume forecast, the report notes, trend toward the lower end of a range of forecasts made in recent years. These forecasts were reviewed against actual 1960 traffic levels, and the indication was that traffic would not achieve the levels of the higher forecasts.

Total of U.S. domestic air passengers, according to the study, will reach 61.6 million in 1965 and 117.2 million in 1980. Growth penetration of the total air traffic market will reach a maximum of 75% on stage lengths under 1,500 mi. and 80% on stage lengths over 1,500 mi. on the study predicts. An exception is the 1,181-1,191 mi. stage length, which includes New York-Miami, and in which the trend predictions are expected to reach 85%.

Decade of Decline

New York's share of the national traffic has been declining for a decade and will continue to do so, according to the study. Among the reasons for the greater expansion of regional and population in other areas, and the diminishing importance of New York as a meeting center for traffic. The latter situation is due to increased saturation with through plane service from other areas which make New York connections unnecessary. Based on

recent trends, the rate of decline of the New York airports is about 0.5% every five years. Projecting this rate, New York will handle 14.65% of the country's passenger loadings in 1965, 14.34% in 1970, and in 1980 will handle 13.11%.

Passenger movements at the New York airports the study forecasts, will reach 18,975,000 in 1965, and rise to 19,747,000 in 1980.

The Port Authority's 1965 passenger estimate indicated a total of 14,700,000.

VTOL Division

VTOL-STOL operations on a commercial basis appear likely in the near future as a result of recent technological developments, according to the United Research study. By 1970, this type of aircraft will divert from fixed wing aircraft 75% of traffic on segment under 100 mi., the study predicts. On trips between 100 and 200 mi., the diversion will be 50%, and on trips between 200 and 500 mi. the diversion will be 25%.

This diversion will account for 11.2% of the New York area traffic in 1970, 1975, and 1980, according to the study. In terms of passenger movements, the VTOL-STOL total will be 4,749,000 in 1980. The diversion will be lighter from still aircraft, as the reduction in the number of fixed-wing aircraft movements will be proportionately greater than the diversion of passengers.

Interrelated to level in and out of the New York area is a decreasing more rapidly than domestic travel, the study finds. The domestic fare structure is causing

Local Station Expense per Originating Passenger New York and Other U.S. Stations: 1958

	Local Station Expense	Originating Passenger	Local Station Expense	Originating Passenger	Local Station Expense	Originating Passenger
	New York	Other U.S. Stations	New York	Other U.S. Stations	New York	Other U.S. Stations
American	\$4,042,137	\$24,362,254	1,000,000	6,161,238	\$4.04	\$3.95
Boeing	272,094	2,064,017	67,524	2,064,017	4.04	3.26
Capital	1,712,000	1,000,000	428,000	1,000,000	4.04	3.26
Delta	1,000,000	1,000,000	250,000	1,000,000	4.04	3.26
Eastern	1,000,000	1,000,000	250,000	1,000,000	4.04	3.26
Northwest	1,000,000	1,000,000	250,000	1,000,000	4.04	3.26
Southwest	1,000,000	1,000,000	250,000	1,000,000	4.04	3.26
Totals	\$10,000,000	\$100,000,000	2,500,000	100,000,000	\$4.04	\$3.95

* Includes aircraft fuel, oil, landing, parking, maintenance, and direct maintenance and airport facilities—general passenger activity.
* Based on 1958 and 1959 data.



**FROM
THE "JENNY"**

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in a manner that discourages traffic. Such fees are being raised in 75% of low-cost fares, although on transcontinental flights the percentage is about 65%. Trend in the other was an occasional travel, lower fares are necessary, but that highest fares. Viewing for the effect of economic operations on aviation travel. New York's international passenger total for 1968 should be 21,662,800.

In examining domestic passenger growth projections, the United Research study, among other things, a 60% airline load factor on a year-round basis. Load factor trend is down, the study finds, and increased seating capacity per aircraft will hold the future annual average load factor to this point.

Cargo traffic will increase at a greater rate than passenger traffic, according to the study. The current proportion of about 1% airfreight flights to total airline service on domestic routes will increase in the forecast period to 2%, and international airfreight flights will account for 1% of total international scheduled service.

Because of the greater capacity of cargo at over its predecessor transport, aircraft construction will not increase in proportion to traffic. Further, the rise in such service will result in additional seats per airplane in the jet era, as given over to higher density configurations.

Fixed-Wing Movement

Annual commercial fixed-wing transport aircraft movements at the New York-New Jersey airports in cargo and passenger service are estimated at 511,461 in 1965 up from 455,500 in 1958; the total will be 666,300 movements in 1975 and 1,441,200 in 1986.

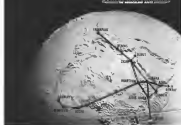
Regarding the capacity of the airports to handle future movements, the study predicts the demand from urban centers at 116.5 peak-hour movements in 1965 and 133.7 movements by 1980. Current capacity of the three airports totals 150 movements per hour. General aviation movements would raise the requirement to 250 movements by 1980, according to the study.

However, technical improvements such as partial automation of air traffic control and high speed turn-off air craft off runways can be expected to raise the capacity to 195-208 movements per hour. The estimate assumes that the new devices are 50% successful if the percentage was 100%, capacity would rise to 240 movements per hour.

It is noted from the above estimates that limitation or removal of general aviation movements at the three airports would place them in peril, with the estimated demand for the forecast period, averaging

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established more speed records (EAP-plus) than any other jetliner. Boeing jets have earned more passengers to more cities than any other jetliner.

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is increased efficiency, increased air traffic.

Airline views on splitting their present operations even further with a fourth airport to serve are unfavorable if a reasonable alternative is available.

The airline view, as it is summarized in the study, involves the following factors:

• Past experience has shown that a New Jersey location (Newark Airport) has been difficult to fill in the total New Jersey-New York metropolitan market.

• Land at Newark have therefore tended to be higher than those at La Guardia and Idlewild.

• Cooperation between airlines are complicated in the multiple airport setup. The problem is acute with the three airport situation and a fourth would complicate it further. About 20% of New Jersey-New York area passengers make connections.

• Scheduling problems also are complicated by the multiple airport complex. This applies to aircraft and flight crews. Connecting services are more difficult to schedule.

• Service costs are generally higher. Propulsion of maintenance and other fixed costs are greater. A burden is placed on carriers whose cost structures often limited access to the total market represented by each airport.

Air Afrique Links 11 Pro-Western Countries

Paris—The recent and largely successful creation of a new African airline by 11 former French Africa territories marks the first serious check to Communist-African influence in West Africa's rapidly expanding air transport sector.

The new grouping—called Air Afrique—was set up by heads of the 11 French-speaking nations. The new airline will be developed with technical aid supplied by Air France and Union Aérienne Maritime de Transport (UAT), a private French carrier. The consortium includes all former French Africa territories except Guinea and French Sudan, now called Mali.

Guinea and Mali recently are receiving considerable air transport aid from the Communist bloc for their new national airlines, Air Guinea and Air Mali. A third West Africa nation, Ghana, also is spending Russian aid and getting technical aid from Commonwealth countries as well as from southern nations.

Creation of Air Afrique marks out the possible nations in tropical regions where east and west could cooperate for leading roles in landing aviation and in selling aircraft.

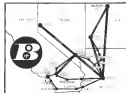
On balance, the Communist bloc has done quite well. It has a strong position in two of West Africa's richest countries, Guinea and Ghana. It also has a firm position in Mali, a poor and politically confused nation. Moreover, Soviet infiltration into the aviation sector in the former Belgian Congo, though temporarily blocked, isn't completely dissipated.

Creation of Air Afrique suggests a new formula for organizing air transport in large regions of Africa. Up to now, most of the new African nations have sought establishment of their own national airlines, rather than seeking the consortium arrangement.

Air Afrique, however, reports the idea of national carrier nations and adopts a far-reaching plan to the Scandinavian countries' SAS consortium. Each of the 11 nations holds 6% interest in Air Afrique while Air France and UAT hold 17% each. The new company will have headquarters at Algiers, on the Ivory Coast. Initial capitalization has been fixed at \$2 million. The first annual meeting is to be held May 25 at Algiers and operations is to begin next July.

Initially, Air Afrique will operate 15 Douglas DC-4 aircraft currently used in West Africa by Air France and UAT. Routes at first will concentrate on linking the 11 nations.

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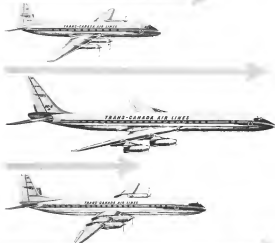


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- TCA PROGRESS** First airline to operate Vickers Vanguards in North America.
- TCA PROGRESS** First and only Cleveland-Europe via-carrier service by DC-8 giant jets—starting this month.
- TCA PROGRESS** New TCA maintenance base in Montreal—the largest structure of its type in the world—can accommodate 11 DC-8's at one time.

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TRANS-CANADA AIR LINES  **AIR CANADA**

Tillinghast Outlines TWA Turbofan Needs

By William H. Gregory

New York—TWA's World Airlines' new president, Clayton C. Tillinghast, Jr., faces three major problems when he takes over the airline's top job, vacant since last summer.

In order of immediacy, he must:

- Equipment requirements of the airline.
- Merger with Northeast Airlines.
- Economics in the broad sense.

TWA will deal only with phase one of its equipment problems now. This is for additional long-range equipment to bring its fleet into balance with its domestic, transcontinental and international competitors, especially with United Air Lines' growing fleet.

Initially, Tillinghast said, TWA prob-

ably will order at least 20 Boeing 707-113B and 707-111B turbofan transports.

Negotiations for financing the purchase, on the order of \$100 million, are under way with generally the same group that provided TWA's financing for purchase of its present fleet of 707's from Hughes Tool Co. and for its fleet of Convair 440's (AW Jan. 9, p. 30).

New Funds

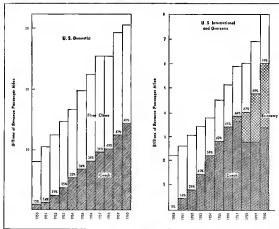
Tillinghast does find himself seeking new funds while final arrangements for a \$114-million unit of TWA debt—two due this month still are being completed. However, bank and insurance company loans—debt capital—was sought for the new order rather than additional equity.

Relative short-haul routes can be adequately handled for the near term

by the 850's, Tillinghast said. TWA's experience has shown that airplanes appear to operate economically on stage lengths down to about 500 mi.

No major configurations are planned in the current order, Tillinghast said. Purchase of other aircraft types jet aircraft or a short-range jet transport of the Sud Caravelle, Boeing 727, or the Harland Transport class, is further down the road. How far, he said, will depend a good deal on financial considerations.

In his initial message to employees, Tillinghast commented that meeting the airline's equipment financing needs will tax its resources severely. "In my opinion," he said, "we can adequately meet these needs only if we prove ourselves capable of operating with constant profitability. No matter how



Coach vs. First-Class Passenger Volume

Study meeting in volume of coach traffic compared with a leveling-off of first-class traffic in during most U.S. domestic and international traffic to avoid raising configurations of airport capacity to accommodate the growing demand for coach. First forecasts indicate that coach traffic will represent for about 35% of all traffic by the end of the year.

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CHARLES C. TILLINGHAST, JR.

could do, reasons for failing to earn a profit, then can never be as persuasive to the owners of capital as success in adequate profits are."

The question of profitability is not so hotly the second and third take as Tillinghast's bet. Northeast's Florida route would eliminate a disadvantage of TWA's route system—the lack of a western route to offset winter season traffic declines.

TWA is not necessarily interested in the Florida route, however, Tillinghast said, though recognizing the value of Miami as a gateway to the Caribbean area and South America as well as a winter resort. Negotiations with Northeast also would come with it a problem for TWA in Northeast's short-haul New England routes work their heavy peaks and valleys in traffic, depending on day of the week or season.

Though Northeast declined another extension on a decision requested by TWA (ENR Apr. 10, p. 41), both airlines still are keeping the door open.

Off-season traffic lulls are one of the reasons, Tillinghast pointed out, for the general rejection of sea service.

It also included:

- Failure of the domestic market to grow as fast as sea routes are growing.
- Multiplicity of carriers on the same route, causing reduced load factors.
- Increasing severity of foreign carrier competition.

Some foreign carriers, subsidized by governments, have the idea that if this idea is even received outside their own nation that they need it as a profitable operation, the TWA product would.

As an example of the increasing competition facing TWA on the North Atlantic, Tillinghast noted the current campaign of both El Al Airlines of Israel and Aeroline Intercontinental, identified themselves with New York-London or New York-Panama routes, rather than routes to their headquarters.

Washington, U.S. carriers can perform an outstanding job, Tillinghast said. But they face tough problems in competing on the transatlantic level. Tillinghast feels the U.S. can be based on better flight times than other nations at the end solution.

For these reasons, Tillinghast expects TWA, like the rest of the industry, to have an indifferent view in 1961. "Indifferent," he said, "meaning eager to beat them good." Free quarters is not necessarily bad, he said, and will be difficult to outbid them during the rest of the year.

In his previous business career, as a lawyer and later as vice president

international operations for the Radio Corp., Tillinghast flew 75,000-100,000 mi. a year as an airline passenger. As a result, he has some strong feelings on passenger service.

Rebels on schedules is one. A businessman who leaves New York in the morning for an appointment in Detroit for lunch is somewhat fed up with getting there on time rather than service critics. TWA's job is to provide both, he said.

Tillinghast's reference on this is ordered as TWA's new passenger service campaign showing its best performance, and in a series of meetings on customer service at New York and



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FACTS *and FIGURES* *about* **AIR TRANSPORTATION**

OFFICIAL PUBLICATION OF THE AIR TRANSPORT ASSOCIATION OF AMERICA

THE STANDARD REFERENCE OF UNITED STATES
SCHEDULED AIR TRANSPORTATION



Table of Contents

At the end of 1960 the air age in scheduled air transportation was two years old.

Despite the fact, as shown in the text and tables, the industry flew more people, more goods and more mail than ever before, the statistical picture for 1960 was discouraging from the profit standpoint. The main reason—what account for 70 per cent of the profits scheduled air transport industry's operations—had to do with operating revenues of nearly two billion dollars, but that net profit was down to only a little more than a million dollars.

The tables this year show the net movement from 1959-1960. Beyond data filed by the scheduled carriers with the Civil Aeronautics Board are the major source of the statistics.

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Definition of Terms

Passenger Miles and Ton Miles

AVAILABLE SEAT MILES FLOWN. Total seat miles (passenger miles) scheduled service.

AVAILABLE TON MILES. Total ton miles of scheduled service.

CHARTER PASSENGER. Transportation of passengers at a rate other than scheduled and designated rates.

EXPRESS TON MILE. A ton of express freight one mile.

PRICED TON MILE. A ton of freight flown one mile.

PASSENGER MILE. One passenger flown one mile.

PASSENGER SEAT FACTOR. The percentage of available seat miles actually sold in scheduled service.

PASSENGER TON MILE. Passenger miles converted to ton miles (one passenger mile equals one ton mile).

REVENUE PASSENGER MILE. The number of fare-paying passengers times the length of trip in miles. This is the amount of revenue per passenger mile.

REVENUE PER PASSENGER MILE. Revenue miles divided by passengers.

REVENUE TON MILE. The ton miles sold in scheduled and charter service.

REVENUE TON MILE. The ton miles sold in scheduled and charter service.

SEAT MILE. One passenger seat mile in scheduled service.

TON MILE. One ton of freight flown one mile.

TON MILE LEAD FACTOR. Percentage of available ton miles sold in scheduled and charter service.

U.S. MAIL, TON MILE. A ton of mail flown one mile. This includes all mail in a shipment (both in transit and in storage).

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STUART G. TAYLOR, President
Air Transport Association
of America

A STATE OF THE INDUSTRY AND PROGRESS REPORT

The enormous contributions the nation's airlines are making to the commerce, economy, and overall strength and progress of the United States are reflected in this report covering the year 1960. This report also shows, however, that in so serving our country, our airlines in 1960 again experienced a year of depressed earnings which seriously threatens their financial stability and hence the possibilities of their continuing to expand and improve their services.

In 1960, despite record traffic volumes and gross revenues, the airline industry's net profits were lower than in any year since 1948. It was the fifth consecutive year of what the Civil Aeronautics Board has termed "a relatively extended period of depressed earnings which exact heavily from the ground."

More service was provided in 1960, and more passenger, freight, express and mail traffic was carried than in any previous year. During the year, the airlines added several hundred new jet-powered planes and committed additional hundreds of millions of dollars to the purchase of more new jets, safety advances, and facilities for improved airline service on the ground.

This constant forward progress, characteristic of airline management efforts over the years, not only has provided a stimulus to national economic activity, but also has—

- exerted a continued growing impact on community development and progress throughout the nation;
- emphasized the airline's major role in the foreign trade position of the United States; and
- elevated the air transport industry to where it has become a practical and symbolic element of national strength in the ideological struggle now being waged in the world.

The year was marked also by significant developments and trends such as:

- in a period of expanding personal travel, the airlines welcomed their load over other forms of public passenger transportation;

- domestic low-fare through traffic, for the first time, exceeded first-class travel during the latter part of the year;
- the popularity of jet travel increased substantially with almost half the total airline passenger-miles accounted for by jet aircraft;
- airfreight continued as the fastest-growing type of airline traffic.

These and other developments illuminated by the facts and figures in this report tell the progress side of the airline story. On the other side, however, is the most serious problem of inadequate airline earnings.

Even in a year when business in general suffered depressed earnings, airline earnings were far below the norm. Thus, the average U.S. corporation made \$1 profit on every \$1 of sales, but the trunk airlines

needed to do \$43 worth of business to make a profit of five cents.

The Government has taken an initial step to help strengthen the airlines' financial position. Last year, after an exhaustive 4½-year investigation, CAB concluded that the airlines needed savings equivalent to a 30½ per cent return on capital investment.

A vast improvement in profits is needed, of course, to achieve that earnings level. At the same time, other corrective steps are necessary. Thus, the Government, to improve profits, must move decisively to:

- eliminate the World War II tax on passengers which stifles needed traffic growth;
- end needless competition for private carriers provided by MATS; the Government-owned service;
- discontinue Government traffic-preference practices which force unreasonably low rates on airlines and other common carriers; and
- cope with the growing foreign airline threat.

Unquestionably, obstacles such as those must be removed. And future Government policies and actions must reflect awareness of the national need for an economically strong air transport industry and the fact that the airlines, in 1960, earned only about 1.56% of what the Government itself has determined is necessary to serve that national need.

We have, in this report, summarized the progress and results of 1960, the more pressing problems, and have taken a look into the future, this in addition to our annual presentation of detailed industry statistics.

Although numerous major United States airlines had a business lull-off in 1960, the U. S. certificated airline industry enjoyed record business volume. The airlines' results show consistency with national economic patterns, however, as that the rate or pace of airline traffic growth slowed down last year.

This is reflected in results in key traffic areas as follows:

- 37,700,000 passengers carried in 1960, up 3,000,000 over 1959—as compared with a gain of some 7,000,000 the previous year.

- \$8.8 billion revenue passenger-miles in 1960, up \$2.6 billion over 1959—as compared with a gain of 5 billion the previous year.

- 648.4 million ton-miles of airfreight in 1960, up 62.4 million over 1959—as compared with a gain of 85 million the previous year.

- 68,648,000 ton-miles of express, a gain of 2.3 million ton-miles over 1959—as compared with a gain of 8 million the previous year.

An exception to this general trend was in the field of mail carriage where growth in 1960 outpaced that for the previous year. Thus, the airlines last year carried 246,586,000 ton-miles of U.S. mail, up 40.3 million over 1959—as compared with a gain of 22.7 million in 1959.

Total operating revenues of all U. S. scheduled airlines reached a record \$2,892,552,000 in 1960, a gain of 10.4 per

At A Glance At Important Statistics	1959	1960	1961*
Number of Airlines	31	4	31
Miles Spent	180	120	70
Aircraft in Service	107	1,000	1,000
Seats Available	1,100	22,000	10,000
Average Speed of Latest Aircraft	414	467	467
Number of People Employed	12,000	75,000	98,000*
Total Flight Hours	23,000,000	30,000,000	30,000,000*
U. S. Mail in Millions	10,000,000	24,000,000	24,000,000*
Number of Passengers Carried	1,000,000	15,000,000	17,000,000*
Average Time To Fly (hrs.)	1.50	1.50	1.50*
Ton Miles of Freight Carried	50,000,000	110,000,000	110,000,000*

* Figures have not been published for 1961. Figures are estimates.

cent over 1959. Similarly, total operating expenses rose to a record high total of \$2,403,575,000 last year, or 12.6 per cent more than the previous year.

Net profit, after taxes and interest, for all carriers was \$9,579,000, down \$61,028,000 from the 1959 total of \$71,567,000.

Passenger Service: The field of airline passenger service was marked in 1960 by such things as:

- Continued service and traffic growth;
- A widening of the passenger-mile gap in favor of airlines over other forms of public transportation;
- Fare adjustments;
- A shifting trend in classes of passenger traffic;
- Emphasis on ground service improvements.



* Figures are for the year 1961 only.

Last year, the airlines provided an all-time high volume of service—65.3 billion available seat-miles, a gain of 6.2 billion over 1959 and more than four times the amount of service provided just ten years ago.

The recent volume of traffic thus accelerated—\$8.8 billion revenue passenger miles—scraped 59.2 per cent of available capacity, a passenger load factor figure which compared with 63.8 per cent in 1959 and 60.3 per cent in 1958.

This constant growth in airline service and public demand therefore, is, of course, one of the most significant elements in our fast-changing world. Ten years ago, the public relied chiefly on railroads and buses for overseas service between U. S. cities. In 1960, domestic inter-city passenger-miles of the airlines was about

as much as those of railroads and buses combined, further widening a lead the airlines assumed in 1955.

As a result of management efficiencies and rapid technological advances, the cost to the public for air transportation has been notably resistant to inflation.

Thus, since 1938, domestic air passenger fares have increased only 13 per cent, as compared to an increase of 166 per cent in consumer prices and 40 per cent in railroad fares over the same period.

The slight air fare increase includes that called for in mid-1960 in the Civil Aeronautics Board's finding that airline profits were too low. That increase amounted to 2 per cent plus \$1 per ticket.

Significantly, there occurred in 1960 a marked increase in the provision of low-fare coach service by domestic airlines and in the utilization of that service by the public. Thus, there was an increase of 19.6 per cent in available coach seat-miles in 1960 over 1959, and an increase of 18.1 per cent in coach passenger-miles.

On the other hand, there was an absolute decline in first-class passenger-miles of 5.1 per cent last year. As a result, coach accounted for 47.2 per cent of total domestic passenger-miles in 1960, up from 42.6 per cent the year before. In several months during the last half of 1960, coach passenger-miles rose to over 50 per cent of the total. Fares for this service, of course, are 35% or more under regular first-class fares.

Meanwhile, the airlines devoted increased attention and resources to improving ground services for airline passengers. The growing scope of this undertaking can be seen in the fact that 50,000,000 reservations were handled by domestic airlines last year and 100,000,000 usually are expected by 1970.

Currently, the airlines spend some \$93 million a year in this area. Additional millions are being poured into new systems of vast complexity and maximum efficiency. One airline, for example, has put \$2,250,000 in a system whereby its agents in almost 100 cities can find out instantly seat availability up to six months ahead on 50,000 itineraries.

Another is installing a centralized auto. reservation system which, in about a year, will serve 1100 sales desks, handle 7500 reservations an hour, process them in 3 seconds

"... geared to the fast growing market."

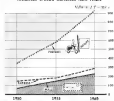
(as compared to 46 minutes now), reduce errors—and cost \$5,000,000 per year.

Throughout the industry, online and interface facilities are being geared to the fast-growing market that must be accommodated.

Airfreight Service. Airfreight developments in 1960 were highlighted by a substantial increase in the cargo-carrying capacity of the certificated airlines. Mostly, this resulted from the greater cargo space aboard the big new jets plus the conversion of many late-model piston-engined planes to all-cargo configurations.

Significantly, there will be a further substantial increase in airline cargo capacity this year as more new jets and converted planes come into service and several carriers take delivery of new prop-jet airliners.

AIRLINES CARGO REACHES NEW HIGH



One immediate effect of this build-up in capacity is that it is requiring a complete re-examination of the entire airfreight rate structure.

Last year's freight volume reached a record high of 645,735,000 ton-miles, up 9.7 per cent over 1959, and 45 times the volume earned in 1914, the first full year of industry airfreight operations. As a result of this rapid growth, airfreight is the second most productive form of traffic carried by the airlines, accounting for 12.5 per cent of total ton-miles of traffic.

Nevertheless, the airlines are gearing themselves to carry much greater quantities. Last year's volume, for example, while a record high for the airlines, represented only .65 of one per cent of the total

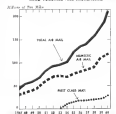
inter-city freight ton-miles moved by all forms of transportation in the U. S.

Great quantities of Government freight, of course, are moved annually via MATS, the Government-owned airline. Much of this, moving between areas served by the certificated airline system, could be accommodated by that system.

Action of this type was called for recently by Senator A. S. Mike Monroney who said:

"It's high time we broke this bottleneck by using Government cargo successfully as a seed bed for a broad new industry of great prospects and promise—and at the same time ensure the kind of stability to a world-wide demand that can help guarantee against a shoddy war—either limited or atomic."

MAIL VOLUMES ARE INCREASING



Mail Service. Vast improvements in the Postal Service were made possible in 1959 as the airlines made increased capacity and speed available and participated in expansion of non-priority mail by air services to the new states of Alaska and Hawaii. Recently, the Civil Aeronautics Board commented:

"The carriers have continued to improve service to the public and make expanded mail services available to the Post Office Department. At the same time, the vast price paid to the carriers for the movement of mail by the Department has declined."

"... the only standard that will be ... satisfactory."

Total U. S. mail volume carried by the certificated airlines last year was 240,279,000 ton-miles, an increase of 17.4 per cent over 1959. Mail traffic accounted for 4.6 per cent of total traffic carried by the airlines and 3.2 per cent of total passenger.

Express Service. Expanded service for air express users resulting from the new partnership agreement between the airlines and the Railway Express Agency showed results as air express traffic gained for the third straight year.

1960 express volume was 58,348,000 ton-miles, up 4.1 per cent over 1959. Express traffic accounts for 4.2 per cent of total airline traffic and slightly under 1 per cent of total revenues.

The Jet Fleet. At the end of 1960, the U. S. certificated airlines operated a fleet of 1,508 aircraft. Included were 470 jet-powered planes of which 224 were pure jets and 246 were prop-jets.

THE 1960* AIRLINE DOLLAR



* For the 12 month period ending December 31, 1960.

AIR SAFETY PROGRESS



This year, the airlines will take delivery of an additional 557 jet-powered planes, consisting of 118 pure jets and 439 turboprops. That will raise the total jet-powered fleet of fixed wing aircraft to 627.

An additional 82 jet planes are scheduled for delivery in the 1962-65 period. Also, 13-turbine-powered helicopters are on order for delivery in 1961-65.

Safety. Last year was the ninth consecutive year in which the fatality rate on the U. S. scheduled air transport system was less than one per 100,000,000 passenger-miles flown.

Actual rate for total domestic and international operations was 0.85 fatalities per 100,000,000 passenger-miles, or about three times better than the fatality rate for passenger automobile travel.

There was a total of nine accidents involving passenger fatalities last year, a year in which the U. S. air carriers performed 3,856,477 scheduled flights (as measured by flight department). Passenger fatalities totalled 337. That is about 146 less than the average for one week on the U. S. highways.

Nevertheless, by the airlines' own rigid safety standards, the 1960 industry record is not considered satisfactory. Most airlines, of course, operated the year without a fatality. An across-the-board zero fatality rate for the entire industry is the only standard that will be considered satisfactory.

Progress to this end is evident in the long-range trend covering consecutive five-year periods. Thus, in the 1940-44 period, the average rate was 2.45 fatalities per 100,000,000 passenger-miles. But, in the latest five-year period, 1956-60, the record was improved to 0.55.

"... a rapidly worsening profit position."

Earnings: The tremendous progress of the airlines in making the civil jet age a reality for the American public has been marred by substantial profits. Last year, for example, the domestic trunk airlines earned only \$1,188,600 on gross revenues of \$1,942,634,000, a profit margin only 1/3rd of the average for all U. S. corporations.

Equally important, 1960 was the fifth consecutive year of depressed earnings for the airlines. These have been five critical years during which the airlines ordered and had to arrange financing for some \$3 billion worth of new jet planes. They have been five years during which extensive training and over-all plant modernization was necessary in preparation for the new planes the first of which started in service in late 1958.

In 1964—on the eve of this critical period—the airlines sought Government permission to take steps to raise fares against the very deterioration in profits that began midway in 1958. The permission was denied.

In the spring of 1966, the Civil Aeronautics Board instituted its General Passenger Fare Investigation, a formal proceeding dealing with airline earnings which lasted four and one-half years. In early 1967, the carriers applied for emergency permission to raise fares in view of a rapidly worsening profit position. That permission was denied.



Early in 1968, CAB recognized the need for fare relief and permitted airlines to raise fares 4 per cent plus \$1 per ticket, or about 8 per cent in total. In the fall of 1968, CAB permitted the elimination

or reduction of certain discounts. These actions were helpful but, it should be noted, they came in the fourth year after the airlines' original request.



Last year, the CAB concluded its general fare investigation. Several of its observations contained in the final decision are worthy of note:

- * "Unfortunately, as contrasted with total revenue growth, airline profits have not only fluctuated but trended downward since mid-1956. While total operating revenues almost doubled between 1953 and 1956, net operating income after taxes was significantly less in 1956 than in 1953."
- * "... the transition to jet equipment which the industry is now undergoing has presented financial and other problems of a magnitude never before faced."

Coupled with these conclusions was a Board finding that fares were still not at an adequate level and CAB suggested an increase of 2 per cent plus \$1 per ticket, effective July 1, 1960. Thus, in three stages, airline fares were raised approximately a total of 24 per cent. Industry efforts aimed at preservation of profit determination were discarded in favor of belated Government "cures".

Nevertheless, while a repeat of this performance in a subsequent modernization program could prove disastrous, there are definite signs of more realistic Government policies in this area.

In winding up its 14-year fare investigation, for example, the CAB noted the unique characteristics of the airline industry and ruled that airline earnings should be equivalent to a 16.5 per cent average

"... swiftly changing industry"

return on investment for extended periods.

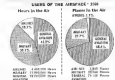
Over the five critical years just passed, the trunk carriers fell far short of reaching that earnings level. Last year, the carriers earned 290 per cent on invested capital, or about \$116,000,000 less than required to attain the needed return.

One of the important reasons it is necessary to improve this picture was stated this very recently by the new CAB Chairman Alan Boyd:

"Today's low (airline) earnings force attention on another of our inordinate problems. Much is (supposedly) in store for us in the face of... Carrier earnings are the only hope for a substantial private enterprise contribution to expensive development—and the nation must develop one. Carrier earnings in the gross immediately stand out as the only hope that a private enterprise air transport system can absorb the vast agricultural transition."

Regulation: The Federal Government has regulated air transportation since 1938. It does so through the Civil Aeronautics Board—in the field of economics and accident investigation—and the Federal Aviation Agency—in technical fields, including safety regulation.

These agencies are the product of Congressional actions expressed first in the Civil Aeronautics Act of 1938 and later in the Federal Aviation Act of 1958.



To date, regulation of air transportation has accomplished much—but also has left much to be desired. Thus, the agencies have, on various occasions, displayed an inability to adjust their thinking and policies to the swiftly changing industry they regulated.

Nevertheless, the ultimate conclusions of CAB in the general fare investigation and recent deliberations by Federal officials indicate a more encouraging regulatory policy will prevail in the future. Hopefully, we have arrived at a turning point where Federal regulation is gearing itself to the dynamics of today.

The vital role that civil aviation now occupies in the nation's social, economic, and political structure requires maximum efficiency in these Congressionally established agencies.

There would, of course, be little hope for such maximum efficiency, and the public benefits that depend thereon, were these agencies to be swallowed up in a single Department of Transportation no seems to be proposed year after year.

To link the interests and problems of civil aviation with all its technical, international, and domestic facets to the interests or problems of surface-based transport companies would not only be impractical but damaging to national interest and counter to the wishes of Congress.

Over a decade ago the U. S. Supreme Court found "no indication that the Congress either entertained or fostered the surface concept that airframe commerce is a mere extension or overgrowth of surface-based transport." Rather, it said, "an enterprise, whether at home or abroad, asserted into a different realm than any that had gone before."

It is the promotion, encouragement, and regulation of such an industry that has been entrusted to CAB and FAA. This country cannot afford the mistake of going backward in this matter—not even for the length of time it might take us to discover and correct our mistake.

Insurpation Tax: One of the most important single actions the Government could take to help our nation's entire common carrier transportation system would be to repeal the 10 per cent tax on passenger transportation.

This tax, imposed directly on passengers, was designed in 1941 as a means of discouraging travel on transportation facilities essential to the war effort.

Today, when airlines, railroads, and buses are dependent on traffic growth, the continuation of a tax designed to achieve the opposite result, does just that—it stifles traffic growth.

"Government must act to strengthen . . ."

As one Congressman put it, this tax "continues to burden the public and to threaten the well-being of an industry essential to the national defense." Numerous bills have been introduced at the present session of Congress to repeal this tax on June 30, 1961.

Cutbacks For Government. Another area where the Government must act to strengthen the common carrier system is in its role as that system's largest single customer.

Almost 15% out of every transportation dollar taken in by the airlines, railroads, steamship and motor carriers combined comes from the Government as a customer. Its impact is about the same as it would be on the automotive industry if the Government purchased three-quarters of a million cars each year.

Yet, while the Government acts to insure fair rates for the public and the carrier, on the one hand, it indulges in cut-rate practices with respect to the traffic it ships via the common carrier system.

When a customer of such size uses its size to chase transportation rates down to uneconomic levels, it not only is injurious to the companies but affects the prices that must be paid by the general public.

The Air Transport Association has urged that the Executive, Congressional,

and regulatory branches of the Government move to correct this problem. Also, we have formally requested the Transportation Association of America, on behalf of the national common carrier system to make this a major undertaking. The aim, simply stated, is to make sure that discrimination in favor of the Government be ended and that rates for Government traffic be made subject to the same regulatory applied to rates for the general public.

Government Competition. The Government-owned airline, Military Air Transport Service (MATS), in fiscal 1960, moved 53 per cent of its passengers and 83 per cent of its cargo between areas served by the nation's certificated air carrier system.

Efforts in 1960 to stimulate greater use of the national air transport system in the movement of the traffic were highlighted by CAA's withdrawal of a "No-bid exemption" in effect since the Korean War, under which a policy of destructive competitive bidding prevailed.

According to CAIL, the effect of that policy over the past ten years "appears to have been the development of what amounts to an overlapping air transport system, operated by MATS, alongside the system authorized by the Board under the Federal Aviation Act to serve the Nation's national defense and commercial needs."

Under CAA's policy, the authority contemplated by the Federal Aviation Act has been maintained and CAA must pass on bids for MATS business. Meanwhile, there is continued strong Congressional support for transferring more of MATS' airline-type traffic to the certificated airlines. This is to strengthen MATS for its true military role by cutting down its commercial airline type activities—and at the same time to strengthen the over-all national airlift capability by realistic use of the national air transport system.

Foreign Competition. The relative position of the U. S. flag airlines in the air travel market between the U. S. and foreign countries deteriorated sharply in 1960. Although the market consists primarily of U. S. citizens—more than 4 out of every 10—the U. S. airlines share of the market dropped to 53.8 per cent. It had been 66.7 per cent the previous year.

Foreign air carriers, who in 1950 carried about 25 per cent of this traffic, thus

"... a major element of national prestige."

increased their share in 1960 to 46.2 per cent. If this trend continues—and there are no signs that it will be interrupted—1961 will give the overseas domination of being the year that the United States surrendered the lead to foreign airlines in the carriage of U. S. international air traffic.

The growth and development of the entire U. S. certificated air carrier system is affected by this development. Under U. S. antiquating policies over the years, not only have more foreign airlines been added in this market but more and more have been given rights to penetrate the domestic U. S. field.

One foreign airline operating from the U. S. west coast to Europe, for example, diverts more than \$3 million annually from U. S. transportation airlines—an amount greater than the entire net profit of the domestic trunklines in 1960.

PASSENGER TRAFFIC BETWEEN THE UNITED STATES AND FOREIGN COUNTRIES



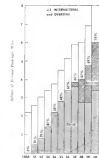
Meanwhile, U. S. flag airlines are facing new developments abroad. Airlines of foreign countries, primarily in Europe, are banding together in pools and combines—dividing services and revenues on specific routes. In some cases, air protectionism is becoming evident with some nations plying a pool or combine leading toward restriction of U. S. airline operations.

To avoid a repeat of the deterioration of our merchant marine—the United States Government quickly and intelligently must responsive its policies in this critical area.

At the same time, the country cannot afford to ignore the significant growth in

the Soviet Airlines, Aeroflot, which is rapidly stretching its massive system to countries throughout the world. Aeroflot has become a raw material for economic and political penetration of non-iron Curtain countries.

REDUCED FARE TRAFFIC CARRIES AN EVER-INCREASING PORTION OF THE TOTAL



Best information available indicates the Soviet airline has some 1800 transport planes in operation including about 300 jet-powered aircraft. It continues to build up at a rapid pace. Its domestic and international system ranges between 350,000 and 600,000 route miles serving 150 to 160 major airports and perhaps another 285 cities without improved airport facilities.

In less than a decade, it has been transformed into a major element of national prestige and political influence for the Soviets—and there are no indications the Russians are content to remain behind the United States in this vital area.

"... the potential for growth ..."

National Impact: Air transportation has become one of the nation's most dynamic forces. It has grown much more rapidly than the general economy. Traffic growth since 1949 is 328 per cent compared to a 92 per cent growth in the Gross National Product.

And the potential for growth in the decade ahead is substantial. CAB has forecast that domestic revenue passenger-miles—which totaled just over 50 billion in 1959—will be about 80 billion by 1969; by 1978, the Federal Aviation Agency forecasts more than 60 billion passenger-miles—double last year's record high.

National Goals: Recognition of this tremendous impact led President Kennedy recently to establish a high-level task force to conduct what has been called "Project Horizons."

The President called for this group to "define and affirm" national aviation goals for the decade ahead.

Out of this project is expected a statement—out of goals that might be accomplished—but national objectives that must be accomplished to maintain our position in world affairs.

U. S. Travel Office: The air transport industry has supported proposed Congressional legislation which would establish, for the first time, a United States travel office to develop tourist travel to this country.

The balance of payments deficit which faced the U. S. in 1959 included a \$1.2 billion deficit in travel and transportation, an amount accounting for 27 per cent of the total deficit. This means there was a substantially greater outflow of tourists and tourist dollars than came into the United States.

As Senator Warren Magnuson described it: "Last year, American tourists flocked abroad in the greatest numbers in history, while travel to our country for foreign visitors showed no significant gain."

The air transport industry supports a positive approach to this problem, i.e., maintaining the growth of U. S. tourism abroad while concentrating on steps to develop substantial growth of foreign visitors to this country.

In addition to the broad social and cultural advantages of such a program, this policy promises national economic gains of significant stature.

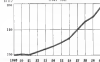
SELECTED INDICES OF GROWTH Local Service Airlines

	1959	1969
Total Cities Served	349	547
Office Served R.O.D./MILE by Local Service Airlines	185	228
Unmanned Route Miles	\$4,769	46,477
Planes in Service	136	302
Miles—miles flown Daily	10,470	234,000
Seating Miles Available Daily	3,441,580	7,347,000
Employees	4,795	12,270

Supersonic Transport: Interest in this country and abroad in supersonic air travel was accelerated in 1960. In this country, most attention was devoted to a Mach 3 plane, i.e., one that would fly about three times the speed of sound or about 2,040 miles per hour.

Sometime, in the near future, perhaps in the 1970s, planes of this type will become a reality for the traveling public. Significant at this time is the national prestige factor involved. England, West Germany, France, and the Soviet Union are reported to be going forward in the supersonic field. Government and industry experts testified before the House Committee on Science and Astronautics last year that the U. S. can't afford to lose out in this competition.

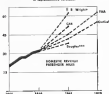
AIRLINE INVESTMENT PER EMPLOYEE 1949-1960



"... a record of accomplishment."

From the airline standpoint, substantial improvement in the earnings position is a key factor in how successful U. S. efforts in this area will be.

POTENTIAL FOR FUTURE GROWTH If supersonic flight



*Division of Field, Civil Aeronautics Administration
**Joint Air to Airline Study Committee, 1959-60
***Graphic Aircraft Company

The facts and figures in this report make apparent the progress, problems, and potential of our national air transport system. They represent the basic material necessary for a true perspective of air transport's vital role in our national affairs.

There is a record of accomplishment underlying all of this—one that shows that the airline industry has consistently provided the pioneering vision and courage needed to expand and improve its service to the public.

We have now entered a period, however, where these qualities are even more in demand and where there is a greater need than ever for a broad understanding of the challenges facing this industry. This report is published so that it might contribute to that end.

Signature

BYRON G. TAYLOR

... In The Public Interest

FOR AIRLINES TO BE INCREASINGLY SAFE, EFFICIENT AND ECONOMICAL

It is one of the Congressional mandates for the "promotion and regulated development" of a sound air transport system and in keeping with objectives and objectives of the United States, domestic, public, and airline should face from these basic principles:

1. Civil aviation is an absolutely essential part of the economic, social, and national defense structure of the country.
2. The growth, modernization, and general price stability of compacted air transportation comprises questions now called for on a broad front.
3. Basic responsibility for airline growth and development has been entrusted by Congress to the air carrier companies.
4. Government interest, action, and concern is necessary in areas consistent with maximum growth, opportunity, safety, and progress. Regulation for regulation's sake need not be imposed.
5. The self-perpetuating characteristics of air transport service and technology should be preserved and encouraged.
6. Where existing impediments to national objectives—such as the World War II travel tax—can be removed, efforts should be directed to that end. At the same time, new economic burdens should be avoided where inconsistent with the national need for a safe, efficient, and economical airline industry.
7. Where airline equipment and facilities can be utilized for Government traffic they should be made available and so utilized to foster maximum growth of the national air transport system and maximum capability of military units.
8. Air transport's significant role as a prime national element in the shifting tides of world trade should continue to be recognized and utilized.
9. United States international air transport policies should reflect the broadened scope and changing nature of foreign airline activity.

AVAILABLE SERVICE AND UTILIZATION



U.S. Scheduled Airline Industry
(In Millions)

	Available Ton Miles flown	Revenue Ton Miles flown	Ton Miles Load Factor (%)	Available Seat Miles flown	Revenue Passenger- miles flown	Passenger- Load Factor (%)	Revenue Passenger Miles flown
Domestic Trunk Airlines							
1955	2,812.2	2,580.1	91.63	32,025.4	19,177.2	60.06	644.9
1956	4,311.2	2,417.0	56.02	31,792.4	21,643.1	68.12	627.1
1957	5,180.4	3,700.0	71.43	31,818.2	24,470.3	76.91	711.1
1958	6,102.2	2,762.0	45.26	34,426.7	24,426.7	70.65	702.6
1959	5,945.0	3,114.8	52.23	41,191.2	28,107.2	68.23	741.8
1960	6,981.1	2,833.9	50.12	41,140.4	27,033.3	65.67	713.8

Local Service Airlines

1955	131.9	80.3	60.96	1,141.4	822.3	72.06	80.9
1956	140.4	69.8	49.71	1,243.0	823.9	66.25	79.5
1957	178.7	78.3	43.80	1,431.8	797.2	55.65	73.3
1958	181.4	86.6	48.31	1,711.8	825.0	48.19	67.3
1959	238.1	101.8	42.77	2,326.2	1,054.3	45.30	104.4
1960	262.3	121.2	46.19	2,254.7	1,141.4	50.61	103.3

Inter-Hawalei Airlines*

1955	16.1	8.4	52.10	134.7	78.1	57.99	4.6
1956	14.0	6.5	46.43	119.9	67.2	56.04	4.6
1957	13.7	5.1	37.16	104.9	59.2	56.49	4.7
1958	12.4	11.7	94.35	94.1	92.9	98.84	4.4
1959	15.1	11.3	74.83	101.7	102.8	101.04	4.3
1960	26.7	17.7	66.26	211.1	175.6	83.19	5.4

Helicopter Airlines (In thousands)

1955	434	193	44.47	1,258	429	34.17	1,140
1956	567	277	48.85	1,844	849	46.03	1,140
1957	1,064	460	43.24	3,549	1,372	38.68	1,104
1958	1,407	591	42.00	4,411	1,846	41.85	1,175
1959	1,705	686	40.24	4,448	1,978	44.47	1,175
1960	2,226	1,254	56.34	4,744	2,478	52.24	1,218

International and Overseas Airlines

1955	944.6	433.6	45.91	7,810.1	4,410.8	56.47	1,107
1956	1,151.6	413.2	35.85	10,712	5,812.2	54.24	1,107
1957	2,102.7	671.9	32.00	10,001.1	5,791.7	57.91	1,107
1958	1,434.6	517.1	36.06	10,011.1	5,791.7	57.91	1,107
1959	1,517.7	517.1	34.10	10,011.1	5,791.7	57.91	1,107
1960	1,922.9	5,144.0	26.74	11,378.3	6,137.2	53.97	1,107

Alaskan Airlines

1955	44.0	31.6	71.82	220.9	155.4	70.36	10.6
1956	44.0	44.0	100.00	214.2	214.2	100.00	11.2
1957	38.6	33.6	86.81	151.7	151.7	100.00	11.8
1958	99.9	39.9	39.97	183.0	183.0	100.00	11.5
1959	11.8	41.2	348.05	111.1	41.2	37.08	11.5
1960	11.8	41.0	347.46	111.1	41.0	37.08	11.5

All-Cargo Airlines

1955	341.0	135.1	39.62	1,111.1	444.4	40.00	13.0
1956	341.0	248.8	72.96	1,111.1	811.1	73.00	13.0
1957	431.7	334.9	77.58	1,111.1	811.1	73.00	13.0
1958	381.9	101.3	26.52	1,111.1	444.4	40.00	13.0
1959	422.1	130.7	31.19	1,111.1	444.4	40.00	13.0
1960	422.1	122.8	29.32	1,111.1	444.4	40.00	13.0

CONSOLIDATED INDUSTRY

1955	9,085.9	8,020.3	88.18	98,545.1	54,988.4	55.80	779.8
1956	12,811.1	8,087.4	62.99	102,444.2	57,417.2	55.98	848.4
1957	17,114.1	9,807.4	57.30	101,941.1	61,321.1	60.23	913.3
1958	22,637.7	10,874.7	48.04	111,941.1	61,321.1	54.80	913.3
1959	22,637.7	10,874.7	48.04	111,941.1	61,321.1	54.80	913.3
1960	26,226.1	12,228.9	46.64	111,941.1	61,321.1	54.80	913.3

NOTE: Available Ton Miles and Revenue Ton Miles include express, airmail, and scheduled cargo. * Includes passenger service to Alaska. ** Includes passenger service to Alaska. *** Includes passenger service to Alaska.

REVENUE TON MILES OF TRAFFIC CARRIED



U.S. Scheduled Airline Industry
(In Thousands
of Revenue Ton Miles)

	Passenger	Freight	Mail	Express	Freight	Freight	Freight	Freight	Total
Domestic Trunk Airlines									
1955	1,034,000	31,000	14,700	48,000	1,034,000	31,000	14,700	48,000	1,127,700
1956	1,034,000	31,000	14,700	48,000	1,034,000	31,000	14,700	48,000	1,127,700
1957	1,034,000	31,000	14,700	48,000	1,034,000	31,000	14,700	48,000	1,127,700
1958	1,034,000	31,000	14,700	48,000	1,034,000	31,000	14,700	48,000	1,127,700
1959	1,034,000	31,000	14,700	48,000	1,034,000	31,000	14,700	48,000	1,127,700
1960	1,034,000	31,000	14,700	48,000	1,034,000	31,000	14,700	48,000	1,127,700

Local Service Airlines

1955	49,713	414	324	1,403	1,345	1,138	248	10,310
1956	62,136	1,112	244	1,147	1,147	1,147	330	10,444
1957	71,279	1,134	244	1,147	1,147	1,147	330	10,444
1958	71,279	1,134	244	1,147	1,147	1,147	330	10,444
1959	71,279	1,134	244	1,147	1,147	1,147	330	10,444
1960	71,279	1,134	244	1,147	1,147	1,147	330	10,444

Inter-Hawalei Airlines*

1955	4,750	39	---	NA	1,444	414	30	8,411
1956	4,750	39	---	NA	1,444	414	30	8,411
1957	4,750	39	---	NA	1,444	414	30	8,411
1958	4,750	39	---	NA	1,444	414	30	8,411
1959	4,750	39	---	NA	1,444	414	30	8,411
1960	4,750	39	---	NA	1,444	414	30	8,411

Helicopter Airlines*

1955	148	90	---	---	6	---	3	198
1956	148	90	---	---	6	---	3	198
1957	148	90	---	---	6	---	3	198
1958	148	90	---	---	6	---	3	198
1959	148	90	---	---	6	---	3	198
1960	148	90	---	---	6	---	3	198

International and Overseas Airlines*

1955	431,100	30,400	---	340	90,000	19,740	17,440	420,740
1956	524,140	60,100	---	---	100,000	22,440	18,340	664,980
1957	589,100	50,400	---	---	123,300	26,440	22,740	731,940
1958	600,140	48,100	---	---	123,300	26,440	22,740	731,940
1959	600,140	48,100	---	---	123,300	26,440	22,740	731,940
1960	600,140	48,100	---	---	123,300	26,440	22,740	731,940

Alaskan Airlines*

1955	11,048	2,274	---	---	7,300	2,712	182	20,234
1956	14,719	2,283	---	---	9,844	19,537	241	26,881
1957	14,719	2,283	---	---	9,844	19,537	241	26,881
1958	14,719	2,283	---	---	9,844	19,537	241	26,881
1959	14,719	2,283	---	---	9,844	19,537	241	26,881
1960	14,719	2,283	---	---	9,844	19,537	241	26,881

All-Cargo Airlines

1955	---	---	---	---	107,940	24,700	---	132,640
1956	---	---	---	---	149,400	29,500	---	178,900
1957	---	---	---	---	149,400	29,500	---	178,900
1958	---	---	---	---	149,400	29,500	---	178,900
1959	---	---	---	---	149,400	29,500	---	178,900
1960	---	---	---	---	149,400	29,500	---	178,900

CONSOLIDATED INDUSTRY

1955	9,085,900	333,400	14,810	31,000	9,450,300	377,710	33,110	9,861,120
1956	12,811,100	333,400	14,810	31,000	13,185,900	411,610	41,910	13,639,420
1957	17,114,100	333,400	14,810	31,000	17,582,900	477,810	47,710	18,108,420
1958	22,637,700	333,400	14,810	31,000	23,016,100	534,010	53,410	23,603,520
1959	22,637,700	333,400	14,810	31,000	23,016,100	534,010	53,410	23,603,520
1960	26,226,100	333,400	14,810	31,000	26,600,500	598,810	59,810	27,259,120

NA Not Available

1. Revenue carried in the year as reported.
2. Passenger ton miles for year as reported were revised to include mail, airmail, and express ton miles as reported by the CAB effective January 1, 1961.
See definition page 70.

* Revenue and carried by International and Overseas and All-Cargo airlines is included in Domestic Airlines. Therefore, it is also included in Consolidated Industry. Express Revenue data.
* Helicopter passenger service begins in 1955.
* Express and Freight combined.



OPERATING

U. S. Scheduled Airline Industry

	U. S. Mail		Public Service Revenue ¹	Express	Freight	Other ²	Total
Passenger	Priority	Non-Priority					
Domestic Trunk Airlines							
1955	1,021,833	34,330	2,708	1,702	19,405	20,931	1,103,349
1956	1,142,157	28,192	2,694	2,697	18,131	43,179	1,243,851
1957	1,287,172	31,000	2,700	1,100	14,442	49,890	1,415,314
1958	1,563,192	33,039	2,616	2,364	14,147	39,345	1,653,349
1959	1,432,646	35,889	3,417	—	10,817	47,054	1,529,406
1960*	1,734,401	40,415	4,333	—	21,785	74,712	1,871,234
Local Service Airlines							
1955	32,940	1,034	181	39,053	445	954	1,311
1956	40,116	1,006	182	35,201	778	780	1,704
1957	47,694	1,129	182	39,451	755	1,049	1,629
1958	54,938	1,225	90	32,764	809	1,115	1,344
1959	71,081	1,476	104	42,191	1,014	1,227	1,179
1960*	83,448	1,753	107	54,696	1,378	1,117	1,335
Island-Hawaian Airlines							
1955	5,936	48	—	291	—	352	307
1956	4,940	51	1	284	—	780	344
1957	4,178	81	2	31	—	781	479
1958	7,863	54	—	109	—	776	1,315
1959	9,954	41	1	144	—	832	1,082
1960*	11,176	40	2	—	—	950	2,817
Helicopter Airlines							
1955	368	280	—	2,712	100	31	64
1956	438	234	—	3,812	115	28	45
1957	548	257	—	3,647	151	34	122
1958	1,499	214	—	4,347	121	31	115
1959	2,310	227	—	4,118	133	38	137
1960*	3,117	245	—	4,350	111	41	146

* Preliminary

¹ Total to October 1, 1959. Public Service Revenues were not reported separately.

REVENUES

(In Thousands of Dollars)

	U. S. Mail		Public Service Revenue ¹	Express	Freight	Other ²	Total
Passenger	Priority	Non-Priority					
International and Overseas Airlines							
1955	214,638	35,459	—	1,581	27	31,805	249,120
1956	342,553	34,924	—	8,308	82	34,643	385,488
1957	377,955	39,265	—	995	80	41,415	419,740
1958	315,991	31,665	—	193	43,893	43,199	394,440
1959	452,018	31,183	—	13	82,253	44,188	569,454
1960*	616,213	40,734	1,052	—	136	54,931	693,029
Alaskan Airlines							
1955	8,143	2,123	—	5,618	—	2,694	3,792
1956	10,200	2,457	—	6,741	—	2,794	7,440
1957	11,343	2,467	—	6,347	—	2,451	27,098
1958	12,530	2,162	—	6,899	—	2,697	21,724
1959	14,465	2,280	—	7,425	—	2,793	21,580
1960*	16,441	2,453	12	9,871	—	3,708	24,481
AS-Cargo Airlines							
1955	—	—	—	—	—	15,948	8,215
1956	—	—	—	—	—	447	25,844
1957	—	—	—	—	—	546	27,281
1958	—	—	—	—	—	580	25,541
1959	—	—	—	—	—	227	28,717
1960*	—	—	—	—	—	107	34,508

CONSOLIDATED INDUSTRY

1955	1,342,379	32,666	3,699	24,127	19,247	95,993	44,941	1,614,969
1956	1,644,096	35,199	3,697	40,480	19,335	106,704	100,471	1,949,501
1957	1,731,672	42,414	3,706	41,394	14,918	116,943	104,123	2,112,497
1958	1,886,186	71,198	3,794	44,641	17,493	119,881	104,361	2,244,155
1959	1,944,254	88,816	5,616	34,710	29,443	121,341	124,440	2,404,956
1960*	2,219,118	91,432	6,429	44,889	29,816	140,889	140,441	2,592,522

¹ Other revenues include revenues from express baggage, box, sign mail and charter operations, and incidental revenues.

² Express and Freight combined.



DISTRIBUTION OF U. S. Scheduled Airline Industry

	General Services & Administration						Depreciation on Aircraft & Equipment	Total Operating Expenses
	Flying Operations	Maintenance	Passenger Service	Aircraft & Traffic Scheduling	Promotion & Sales	Administrative		
Domestic Trunk Airlines								
1955	302,911	179,100	32,776	120,274	124,729	48,475	407,448	1,013,243
1954	340,679	279,630	33,932	120,859	129,344	79,442	479,708	1,163,339
1953	434,842	270,120	70,525	117,201	137,841	93,144	523,428	1,377,574
1952	417,518	284,126	91,317	251,809	145,544	54,849	593,124	1,418,123
1951	535,044	344,381	122,427	275,328	191,792	44,790	470,312	1,499,354
1950*	648,123	377,834	492,365	380,476	315,493	19,307	345,493	1,927,709

Local Service Airlines								
1955	18,990	19,184	2,447	9,542	5,817	4,496	26,822	72,769
1954	21,614	12,410	2,196	11,447	10,377	5,232	31,251	62,713
1953	26,920	14,418	4,608	31,142	6,689	4,719	36,318	73,700
1952	27,347	18,573	4,820	34,342	7,016	6,844	40,144	79,334
1951	34,331	24,781	6,880	31,188	9,211	6,932	52,411	122,800
1950*	42,034	31,263	7,796	34,882	11,594	8,125	62,497	149,040

Inter-Hawaleian Airlines								
1955	1,942	1,378	246	1,258	1,046	764	3,512	7,825
1954	2,022	1,399	262	1,217	1,182	948	3,377	7,207
1953	2,112	1,422	276	1,621	1,266	869	3,752	8,261
1952	2,426	1,616	411	1,671	1,283	1,223	4,170	9,261
1951	2,574	1,913	464	1,848	1,734	1,223	5,383	10,771
1950*	4,264	3,282	429	2,717	2,044	1,736	6,527	14,813

Helicopter Airlines								
1955	414	271	21	425	140	272	1,019	2,026
1954	467	291	21	346	212	476	1,075	2,054
1953	5,128	1,384	—	—	—	—	1,318*	6,144
1952	4,414	1,418	—	—	—	—	1,592*	5,744
1951	4,476	2,012	—	—	—	—	2,142*	7,111
1950*	1,594	2,948	—	—	—	—	2,715	8,562

* Preliminary

* Detailed expense data not reported

OPERATING EXPENSES

(In Thousands of Dollars)

	General Services & Administration						Depreciation on Aircraft & Equipment	Total Operating Expenses
	Flying Operations	Maintenance	Passenger Service	Aircraft & Traffic Scheduling	Promotion & Sales	Administrative		
International & Overseas Airlines								
1955	406,551	58,076	26,778	48,950	41,780	31,271	147,024	345,404
1954	421,415	73,047	31,252	51,500	73,022	33,406	147,344	419,941
1953	442,944	72,126	33,517	47,147	70,002	34,422	170,237*	488,848
1952	554,048	79,072	28,514	72,716	75,709	34,412	210,475*	674,471
1951	641,320	85,742	41,192	60,000	65,846	27,417	258,125*	805,341
1950*	700,994	94,345	48,333	64,254	100,311	27,384	270,148	973,344

Alaskan Airlines								
1955	7,170	8,212	273	2,291	1,953	1,317	4,914	15,120
1954	9,959	6,744	544	1,762	1,331	1,074	8,201	23,144
1953	8,414	4,715	884	2,779	1,242	892	10,945*	16,846
1952	8,270	4,218	920	3,321	1,049	1,795	16,478*	19,224
1951	10,408	3,720	1,334	3,441	1,311	1,268	17,880*	23,427
1950*	10,767	3,913	1,349	3,795	1,243	1,402	12,195	24,19

All Cargo Airlines								
1955	10,425	6,267	347	2,074	2,871	2,123	4,247	24,345
1954	11,427	11,142	1,414	4,253	3,053	2,454	13,124	33,879
1953	24,543	10,519	3,419	12,480	4,444	4,705	25,290*	67,754
1952	31,921	10,920	3,423	8,738	2,412	4,788	19,146*	71,772
1951	39,461	12,899	4,056	9,510	2,995	4,476	18,403*	74,127
1950*	32,426	18,313	1,770	9,402	3,343	4,703	19,824	79,777

CONSOLIDATED INDUSTRY

1955	446,024	278,203	143,746	178,367	213,872	190,238	431,748	1,345,229
1954	522,949	348,499	151,542	197,814	245,793	195,944	522,773	1,447,677
1953	625,047	327,648	154,620	220,356	248,922	205,844	712,533*	1,715,148
1952	644,449	412,877	164,102	241,742	232,471	215,706	842,740*	2,025,120
1951	749,894	499,400	215,747	401,091	329,544	244,441	966,908*	2,448,882
1950*	871,742	614,664	267,444	463,104	322,627	212,408	1,121,138	2,816,087

* Total is greater than sum of individual expense categories since aggregation of expenses is not reported by all carriers.



SUMMARY OF U. S. Scheduled Airline Industry

PROFIT OR LOSS (In Thousands of Dollars)

	Total Operating Revenues	Total Operating Expenses	Net Operating Income	Interest on Long-Term Debt	Other Items Operating Income (Net)	Income Taxes	Net Profit or Loss *	Ratio of Return on Investment %	Profit Margin on Sales %
Domestic Trunk Airlines									
1955	1,110,348	1,018,047	122,271	4,548	14,388	79,434	43,683	11.8	8.6
1956	1,242,821	1,162,237	180,481	5,764	23,917	84,842	117,712	9.4	4.6
1957	1,419,834	1,219,874	42,034	14,201	18,681	22,874	26,766	4.9	1.9
1958	1,513,349	1,408,123	75,124	24,454	36,388	44,733	46,799	4.2	3.0
1959	1,770,420	1,492,216	195,215	32,214	41,721	83,640	41,681	7.3	3.4
1960*	1,942,414	1,707,316	244,848	40,767	21,734	119,113	5,188	2.8	0.1

Local Service Airlines

1955	57,480	54,348	484	219	149	414	312	2.7	0.4
1956	67,712	69,270	(201)	374	134	(10)	(97)	(—)	(—)
1957	83,139	81,930	(742)	224	(472)	(10)	(1,192)	(—)	(—)
1958	94,883	91,326	4,417	898	267	394	5,137	3.9	4.2
1959	122,832	121,049	743	1,944	1,188	(177)	232	5.4	0.2
1960*	144,819	141,263	1,738	2,494	893	(31)	1,420	7.8	1.1

Inter-Hawaleen Airlines

1955	7,114	3,005	(101)	104	219	8	(138)	(—)	(—)
1956	7,408	2,887	129	97	(14)	—	12	3.1	0.2
1957	8,546	8,881	276	129	254	83	267	11.0	2.3
1958	9,270	9,264	127	144	(1)	(118)	1.2	(—)	(—)
1959	11,402	11,271	104	289	(11)	(37)	84	9.4	0.8
1960*	14,791	14,813	(82)	417	39	(121)	—	—	—

Helicopter Airlines

1955	3,288	2,765	400	14	116	302	342	10.3	10.3
1956	2,711	2,454	88	23	(40)	8	(37)	(—)	(—)
1957	5,632	5,144	(124)	64	(5)	(142)	(111)	(—)	(—)
1958	4,188	3,762	227	84	18	112	491	11.4	7.9
1959	7,742	3,311	449	79	229	309	851	10.7	4.8
1960*	8,401	4,782	319	41	19	72	180	2.3	1.7

	Total Operating Revenues	Total Operating Expenses	Net Operating Income	Interest on Long-Term Debt	Other Items Operating Income (Net)	Income Taxes	Net Profit or Loss *	Ratio of Return on Investment %	Profit Margin on Sales %
International and Overseas Airlines									
1955	304,324	285,428	18,700	1,780	4,754	10,219	13,424	4.3	3.5
1956	422,846	419,541	3,304	5,000	8,118	17,792	20,801	8.2	4.6
1957	467,944	468,848	20,000	4,893	8,419	62,292	19,320	7.8	4.8
1958	504,942	496,471	18,469	5,759	9,099	5,437	6,944	3.2	1.3
1959	565,454	547,348	18,106	8,487	(1,188)	10,000	12,917	4.7	2.3
1960*	613,120	613,348	45,134	14,793	9,708	14,906	15,186	5.4	2.3

Alaskan Airlines

1955	33,324	31,776	519	74	238	104	434	8.0	3.0
1956	29,182	31,164	3,186	222	(19)	479	974	15.1	2.4
1957	27,008	24,875	413	362	729	(7)	900	11.1	3.3
1958	38,924	31,628	1,100	418	180	475	311	8.7	1.4
1959	31,680	31,427	148	482	504	319	(299)	3.2	(—)
1960*	34,481	34,192	2,489	647	201	792	844	8.1	2.4

All-Cargo Airlines

1955	27,025	26,346	472	561	1,123	92	1,163	9.4	4.4
1956	52,440	52,479	(101)	488	4,899	5,219	1,423	7.0	1.4
1957	60,129	61,324	(4,454)	1,824	4,222	285	(2,287)	(—)	(—)
1958	74,851	76,149	(2,298)	1,572	1,455	(348)	(1,794)	(—)	(—)
1959	71,128	74,127	(3,009)	1,410	2,823	4,019	2,418	(—)	(—)
1960*	74,584	74,975	(3,419)	1,404	(1,791)	(7)	(3,819)	(—)	(—)

CONSOLIDATED INDUSTRY

1954	1,454,945	1,469,774	346,154	5,919	25,736	81,482	79,723	10.6	4.9
1955	1,879,543	1,742,873	1,366,671	14,175	34,154	74,675	26,763	6.6	4.0
1957	3,115,429	3,069,919	443,511	23,348	31,440	26,482	46,393	5.1	2.0
1958	3,324,099	3,129,191	194,908	39,915	36,744	15,448	49,228	5.2	2.2
1959	3,468,964	3,488,768	122,196	45,994	14,704	40,219	71,467	4.8	3.7
1960*	3,892,102	3,690,176	79,977	63,471	24,124	20,326	6,179	2.3	0.5

* Preliminary. † Domestic service only.

† Net Profit or Loss for 1957, 1958, 1959 and 1960 is shown after "Domestic Items," which are not included in the above. Therefore, the items do not add to the profit figures shown.

‡ Net Income before interest and after taxes as percent of average cost of work and long-term debt.

* Profit as percent of revenues.



ASSETS, LIABILITIES AND

U. S. Scheduled Airline Industry

	1955	1954	1953	1952	1951	1950	1949
Dominion Truck Airlines*							
Assets							
Current Assets	434,109	439,937	467,611	495,764	455,791	467,206	
Investments and Special Funds	419,408	366,147	127,743	334,163	132,261	137,940	
Flight Equipment	985,095	981,000	1,343,747	1,511,141	1,894,276	2,172,338	
Reserve for Depreciation and Maintenance	419,482	366,793	497,919	758,021	875,787	919,157	
Accumulated Reserve						15,611	
Ground Property and Equipment	354,184	360,512	364,482	327,440	277,817	300,206	
Reserve for Depreciation	71,602	49,217	301,281	115,209	115,551	147,814	
Other Property	9,400	41,150	41,163	320,465	356,820	34,729	
Deferred Charges	6,400	13,294	23,541	20,704	65,142	79,808	
Other Assets	1,776	4,388					
Total Assets	1,861,145	1,599,132	1,469,901	1,707,519	2,040,371	2,294,719	
Liabilities and Equity							
Current Liabilities	276,839	331,476	339,444	321,769	434,029	524,383	
Long Term Debt	179,716	204,071	497,434	189,713	634,679	561,491	
Other Non-Current Liabilities			1,324	17,712	3,015	3,097	
Operating Reserves	9,342	12,970					
Deferred Credits	23,016	37,444	\$1,480	78,419	114,644	131,311	
Shareholders' Equity—Net of Treasury Stock	364,139	\$76,449	631,517	467,071	346,354	240,327	
Preferred Stock	29,799	18,912	18,912	34,500	19,651	19,651	
Common Stock	18,172	18,935	189,936	171,417	176,457	199,908	
Other Paid-In Capital	141,619	177,018	278,212	236,108	262,121	236,141	
Retained Earnings	263,237	261,472	268,329	315,493	343,428	331,447	
Total Liabilities and Equity	1,011,145	1,239,132	1,469,901	1,707,519	2,040,371	2,294,719	
Local Service Airlines							
Assets							
Current Assets	12,930	14,871	16,512	20,000	29,897	34,941	
Investments and Special Funds	790	1,493	5,024	2,974	2,085	2,359	
Flight Equipment	21,461	26,106	33,947	46,359	67,350	76,340	
Reserve for Depreciation and Maintenance	11,756	12,435	16,355	20,442	22,000	23,472	
Accumulated Reserve						4,642	
Ground Property and Equipment	6,132	5,795	5,544	3,914	9,869	10,814	
Reserve for Depreciation	2,333	2,947	4,117	4,172	4,348		
Other Property	682	5,912	6,071	1,951	1,951	1,914	
Deferred Charges	865	1,544	1,931	2,050	2,104	4,383	
Other Assets	2						
Total Assets	28,411	37,628	40,799	54,403	66,566	64,331	
Liabilities and Equity							
Current Liabilities	12,461	17,401	22,982	26,124	36,214	37,917	
Long Term Debt	6,813	7,608		4,154	48,773	48,773	
Other Non-Current Liabilities			285	263	4,873	1,817	
Operating Reserves	361	1,238					
Deferred Credits	301	31	204	230	711	232	
Shareholders' Equity—Net of Treasury Stock	11,250	11,280	12,763	12,688	14,622	13,723	
Preferred Stock	412	550	543	143	261	343	
Common Stock	4,268	4,736	4,736	4,888	4,888	4,888	
Other Paid-In Capital	4,324	6,691	6,663	6,223	7,080	7,080	
Retained Earnings	53	1,001	11,291	1,094	7,081	17,864	
Total Liabilities and Equity	28,411	37,628	40,799	54,403	66,566	64,331	

* Balance sheet data for domestic trunk airlines reflect their interest in as well as domestic operations. They are not included in International and Overseas.

* Has been revised in the past as Domestic Airlines.
† Does not include maintenance reserve in 1950.

STOCKHOLDERS' EQUITY

(In Thousands of Dollars)

	1955	1954	1953	1952	1951	1950	1949
International Airlines*							
Assets							
Current Assets	1,548	1,246	1,164	2,122	3,449	3,445	
Investments and Special Funds	18	18	112	15	19	219	
Flight Equipment	5,746	6,057	6,912	7,861	11,134	14,341	
Reserve for Depreciation and Maintenance	2,628	2,190	2,718	4,106	3,919	3,919	
Accumulated Reserve						1,561	
Ground Property and Equipment	1,177	1,176	1,154	1,021	1,737	1,561	
Reserve for Depreciation	349	847	948	1,043	1,147	1,349	
Other Property	40	17	119	101	144	230	
Deferred Charges	180	349	621	633	899	1,276	
Other Assets							
Total Assets	4,441	4,916	5,983	9,236	12,611	15,221	
Liabilities and Equity							
Current Liabilities	1,329	1,830	2,811	2,884	2,678	2,948	
Long Term Debt	1,838	1,763	1,426	2,611	4,164	7,743	
Other Non-Current Liabilities							
Operating Reserves	30	41					
Deferred Credits	1	48	23	3	59	142	
Shareholders' Equity—Net of Treasury Stock	1,084	1,647	1,804	1,589	1,767	2,171	
Preferred Stock						1,200	
Common Stock	1,180	1,180	1,180	1,267	1,267	1,267	
Other Paid-In Capital	174	150	433	1,108	1,171	1,171	
Retained Earnings	11,199	11,146	11,900	11,588	11,611	11,611	
Total Liabilities and Equity	4,441	4,916	5,983	9,236	12,611	15,221	
Receptor Airlines							
Assets							
Current Assets	2,965	2,307	2,148	2,994	3,914	3,263	
Investments and Special Funds	231	280	37	34	34	34	
Flight Equipment	3,658	3,610	5,130	6,021	6,467	5,774	
Reserve for Depreciation and Maintenance	1,111	1,446	2,314	3,611	2,944	2,608	
Accumulated Reserve						1,571	
Ground Property and Equipment	712	816	777	838	973	973	
Reserve for Depreciation	317	317	311	374	468	468	
Other Property	14	71	1	4	50	57	
Deferred Charges	161	164	303	427	461	615	
Other Assets							
Total Assets	4,293	5,494	5,769	7,314	7,864	7,275	
Liabilities and Equity							
Current Liabilities	581	726	861	1,604	2,029	1,943	
Long Term Debt	47	817	1,618	1,317	264	364	
Other Non-Current Liabilities							
Operating Reserves	10	46					
Deferred Credits	28	49	158	4	92	247	
Shareholders' Equity—Net of Treasury Stock	3,519	3,611	3,495	4,363	4,687	4,767	
Preferred Stock							
Common Stock	477	502	536	571	571	596	
Other Paid-In Capital	2,320	2,435	2,444	2,661	2,686	2,644	
Retained Earnings	441	473	418	730	1,210	1,210	
Total Liabilities and Equity	4,293	5,494	5,769	7,314	7,864	7,275	



ASSETS, LIABILITIES AND

U. S. Scheduled Airline Industry

	1960	1959	1957	1956	1955	(Revised) 1954
International and Overseas Airlines¹						
Assets						
Current Assets	109,819	111,605	102,383	116,391	142,381	145,719
Investments and Special Funds	21,230	27,961	32,892	30,210	108,963	44,217
Flight Equipment	314,757	345,746	374,786	364,424	402,444	409,247
Reserve for Depreciation and Maintenance ²	19,281	114,524	122,186	149,283	169,189	149,283
Accumulated Reserves	—	—	—	—	9,134	—
Ground Property and Equipment	37,995	31,613	34,151	35,794	40,517	39,361
Reserve for Depreciation	18,424	18,614	20,761	22,345	25,942	24,424
Other Property	3,714	4,485	4,709	4,585	4,950	4,338
Deferred Charges	1,761	4,440	4,413	9,573	15,622	34,950
Other Assets	—	—	—	—	—	—
Total Assets	574,455	571,243	557,029	574,729	634,489	644,057
Liabilities and Equity						
Current Liabilities	80,941	92,182	87,424	86,259	104,491	131,480
Long-Term Debt	60,481	61,406	65,452	67,254	20,228	28,144
Other Non-Current Liabilities	—	—	—	779	1,458	2,204
Operating Reserves	1,319	1,844	—	—	—	—
Deferred Credits	1,844	6,239	4,448	4,448	9,819	20,227
Stockholders' Equity—Net of Treasury Stock	127,148	126,847	141,710	162,176	199,127	148,495
Preferred Stock	—	—	—	—	—	—
Common Stock	13,422	13,770	14,312	16,442	16,779	17,049
Other Paid in Capital	43,139	63,449	63,129	34,296	76,120	76,120
Retained Earnings	162,378	161,117	162,864	163,214	167,612	177,776
Total Liabilities and Equity	574,455	571,243	557,029	574,729	634,489	644,057
Alaskan Airlines						
Assets						
Current Assets	8,800	9,129	9,681	9,271	9,889	9,886
Investments and Special Funds	344	812	448	537	728	728
Flight Equipment	4,564	11,034	10,648	14,438	26,985	26,875
Reserve for Depreciation and Maintenance ²	4,981	8,939	8,092	8,401	7,719	7,719
Accumulated Reserves	—	—	—	—	8,645	—
Ground Property and Equipment	2,958	4,331	4,441	4,609	6,139	6,731
Reserve for Depreciation	1,631	1,868	2,138	2,417	2,820	2,140
Other Property	143	143	112	248	312	312
Deferred Charges	354	417	418	899	817	540
Other Assets	118	—	—	—	—	—
Total Assets	18,709	18,617	18,810	24,051	26,704	34,311
Liabilities and Equity						
Current Liabilities	4,002	6,170	7,664	8,035	8,148	9,118
Long-Term Debt	745	2,340	4,942	3,848	2,442	4,483
Other Non-Current Liabilities	—	—	—	—	—	—
Operating Reserves	487	23	—	—	—	—
Deferred Credits	870	48	104	112	141	141
Stockholders' Equity—Net of Treasury Stock	9,112	6,167	3,714	8,112	8,055	8,014
Preferred Stock	—	—	—	—	—	—
Common Stock	2,710	3,152	3,415	4,281	348	347
Other Paid in Capital	7,402	3,015	3,429	3,830	3,454	3,454
Retained Earnings	(1,170)	114	719	152	457	1,444
Total Liabilities and Equity	18,709	18,617	18,810	24,051	26,704	34,311

¹ Balance sheet data for domestic trunk airlines reflect this International as well as domestic operations. They are not included in International and Domestic.

² This has been carried in the past as Treasury Stock.
³ Does not include accumulated reserves in 1954.

STOCKHOLDERS' EQUITY

(As of Sept. 30, 1955, in Thousands of Dollars)

	1960	1959	1957	1956	1955	(Revised) 1954
All-Cargo Airlines						
Assets						
Current Assets	11,714	20,234	19,881	35,182	20,482	34,940
Investments and Special Funds	3,958	12,244	4,429	1,257	30,820	29,321
Flight Equipment	24,141	34,942	40,445	36,790	41,215	47,215
Reserve for Depreciation and Maintenance ²	—	—	1,050	17,822	22,152	16,444
Accumulated Reserves	—	—	—	—	—	1,118
Ground Property and Equipment	2,743	4,444	4,678	4,458	4,714	4,714
Reserve for Depreciation	1,913	1,812	2,182	2,747	3,178	3,234
Other Property	199	3,028	2,182	4,812	789	1,674
Deferred Charges	412	3,775	5,125	4,740	5,223	1,655
Other Assets	140	281	—	—	—	—
Total Assets	21,467	49,144	51,147	71,427	82,588	77,057
Liabilities and Equity						
Current Liabilities	18,709	19,881	20,791	22,286	18,861	17,217
Long-Term Debt	7,719	14,413	38,121	17,822	26,247	27,776
Other Non-Current Liabilities	—	—	449	1,958	1,601	708
Operating Reserves	1,409	2,217	1,787	3,126	3,438	3,437
Deferred Credits	1,202	3,768	2,495	16,171	17,778	18,127
Stockholders' Equity—Net of Treasury Stock	(1,202)	3,768	2,495	16,171	17,778	18,127
Preferred Stock	—	—	—	—	—	—
Common Stock	3,444	4,962	6,027	8,981	10,262	10,424
Other Paid in Capital	4,384	11,741	14,721	17,287	21,249	21,249
Retained Earnings	1,202	4,201	2,614	11,422	14,277	12,444
Total Liabilities and Equity	21,467	49,144	51,147	71,427	82,588	77,057
CONSOLIDATED INDUSTRY						
Assets						
Current Assets	119,247	199,761	187,764	165,473	186,176	189,437
Investments and Special Funds	45,883	102,412	143,691	134,719	167,123	189,334
Flight Equipment	1,647,584	1,444,789	1,763,674	1,748,634	2,049,732	2,197,244
Reserve for Depreciation and Maintenance ²	848,623	698,757	877,175	755,742	1,044,134	1,184,014
Accumulated Reserves	—	—	—	—	—	30,248
Ground Property and Equipment	174,871	225,899	225,099	199,659	244,489	267,743
Reserve for Depreciation	109,412	115,445	121,678	140,289	147,934	146,484
Other Property	25,492	31,917	32,448	33,449	34,449	34,231
Deferred Charges	15,881	22,341	24,118	47,494	81,119	144,919
Other Assets	1,485	4,768	—	—	—	—
Total Assets	1,849,616	1,727,342	1,969,317	2,026,406	2,466,144	2,649,339
Liabilities and Equity						
Current Liabilities	984,095	471,846	674,227	628,442	828,192	798,486
Long-Term Debt	127,476	427,949	596,936	691,140	1,134,738	1,207,282
Other Non-Current Liabilities	—	—	2,114	—	9,114	36,115
Operating Reserves	14,710	15,880	18,885	18,876	18,876	18,126
Deferred Credits	25,214	40,442	40,442	40,442	40,442	40,442
Stockholders' Equity—Net of Treasury Stock	648,399	768,849	638,872	694,758	745,774	767,177
Preferred Stock	37,840	37,840	37,840	34,469	27,469	21,466
Common Stock	1,191,919	1,080,914	1,044,140	1,044,140	1,044,140	1,044,140
Other Paid in Capital	208,847	347,428	348,192	348,192	348,192	348,192
Retained Earnings	98,793	344,494	348,480	277,127	419,254	419,254
Total Liabilities and Equity	1,849,616	1,727,342	1,969,317	2,026,406	2,466,144	2,649,339

REVENUE PASSENGERS CARRIED

★ U.S. Scheduled Airline Industry
(For Selected Years, In Thousands
of Passengers)

	1919	1949	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Domestic	1,712	14,301	22,621	22,769	26,177	29,926	34,810	37,988	40,270	39,913	44,489	48,779
Transit	—	—	476	1,961	3,734	2,832	2,402	2,897	2,402	2,943	4,346	5,911
Inter-Route Airlines	20	183	190	318	363	561	580	637	589	512	750	857
Reliance Airlines	—	—	—	—	1	6	28	42	148	239	364	490
International and Overseas Airlines	129	1,220	2,024	2,342	2,663	2,846	3,379	3,888	4,008	4,176	4,767	5,263
Alaskan Airlines	—	—	—	187	194	330	326	264	318	369	319	344
TOTAL DOMESTIC AND OVERSEAS	1,841	16,703	26,645	27,844	31,633	36,482	41,420	45,944	48,239	47,047	53,706	57,709

AVERAGE LENGTH OF HAUL (statute miles)

	1919	1949	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Domestic	397	449	490	513	547	590	567	576	608	610	602	647
International and Overseas	317	1,351	1,276	1,278	1,261	1,216	1,207	1,210	1,405	1,429	1,468	1,544

1 Alaskan data for 1949 include shorter flights. 1928

2 Beginning in 1957 passenger miles reported on a basis which yielded slightly lower figures than the basis used in prior years. This measure is just for the typical measure of average length of haul in 1957 as compared to 1954.

AVERAGE REVENUE PER PASSENGER MILE

★ Inter-city Common Carriers
(For Selected Years, In Cents per Mile)

	1919	1949	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Domestic Scheduled Airlines*	—	—	2.96	4.19	4.45	4.18	4.02	4.24	4.32	4.29	4.35	4.43
Overseas	—	—	8.38	6.25	6.34	6.17	6.54	6.43	6.37	6.32	6.28	6.30
International Scheduled Airlines	—	—	—	—	—	—	—	—	—	—	—	—
Overseas	—	—	8.57	7.72	7.28	7.12	7.04	6.88	6.79	6.49	6.76	6.84
Domestic, Class II	—	—	—	—	—	—	—	—	—	—	—	—
First Class	—	—	3.10	3.14	3.25	3.29	3.35	3.38	3.39	3.41	3.46	3.54
Coach	—	—	1.80	2.40	2.47	2.47	2.53	2.52	2.56	2.47	2.56	2.77
Inter-city Motor Buses, Class I	1.00	1.05	1.18	1.05	0.93	0.84	0.88	0.86	0.82	0.80	0.78	0.76

* Truck and motor intercity
+ 10 months 1949. Excludes common carriers (bus and truck)
+ payments to National Company for seat, berth, etc.
+ AIA common

2 Not available

TREND OF REVENUE PASSENGER MILES BY CLASS OF SERVICE

★ U.S. Scheduled Airlines
(In Millions)

	Domestic*			International and Overseas		
	Coach	First Class	Total	Business	Tourist	First Class
1951	1,378	9,223	10,601	—	418	2,194
1952	1,386	10,199	11,585	—	460	2,287
1953	1,319	10,148	11,467	—	426	2,374
1954	1,321	11,219	12,540	—	470	2,391
1955	1,316	12,024	13,340	—	479	2,401
1956	1,319	12,252	13,571	—	477	2,413
1957	1,310	12,734	14,044	320	444	2,459
1958	1,310	13,192	14,502	348	478	2,523
1959	1,304	14,647	15,951	310	517	2,584
1960	1,417	15,027	16,444	307	517	2,584

* Frontier and Local Service

DOMESTIC INTERCITY PASSENGER MILES

★ (For Selected Years, In Millions)

	1938	1949	1952	1954	1957	1958	1959	1960
Scheduled Service								
First Class	7,827	9,948	8,840	8,278	8,188	8,249	8,752	8,850
Coach	11,280	20,218	17,129	17,105	16,145	14,730	15,749	15,330
Air Travel								
First Class	104	4,444	13,025	14,282	15,356	15,180	16,447	16,987
Coach		261	4,714	6,474	9,812	10,024	12,204	14,418
Motor Bus Travel		9,100	22,411	16,842	16,377	15,063	16,601	16,430
Total Domestic	29,448	58,775	46,773	42,698	42,175	40,816	43,425	41,718
Air Travel of Total	2	2	174	2,857	459	42	473	497
Atlantic Steamship, Inc.	134,748	374,113	581,600	677,000	644,800	629,476	659,425	688,000
Total Overseas Grand Total	165,196	432,226	648,374	679,758	767,975	689,314	723,588	734,126
All-Over Sales of Total Intensity	9.3	1.6	3.1	3.3	3.6	3.7	4.0	

COMPARATIVE TRANSPORT SAFETY RECORD



Passenger Fatality Rate per 100,000,000
Passenger Miles (For Selected Years)

	1929	1949	1952	1953	1954	1955	1956	1957	1958	1959	1960
Domestic Scheduled Airlines											
Fatality Rate	—	9	13	44	56	16	16	143	35	115	75
Rate	4.50	1.30	27	39	70	79	94	12	45	70	1.10
International and Overseas Scheduled Airlines											
Fatality Rate	15	4	94	3	0	2	9	40	11	58	1
Rate	12.92	19	218	54	04	04	17	47	16	84	0.21
Total U. S. Scheduled Airlines											
Fatality Rate	—	19	97	142	56	18	183	183	46	173	127
Rate	5.99	1.60	9.94	6.44	8.07	6.62	9.50	9.30	6.39	6.70	0.66
Other Lines											
Fatality Rate	—	139	120	100	40	79	88	90	128	188	n.a.
Rate	—	23	21	18	11	18	18	17	24	38	n.a.
Reflected Passenger Miles											
Fatality Rate	31	29	34	55	25	19	57	17	42	13	33+
Rate	14	28	54	16	21	37	27	27	27	19	19+
Passenger Airmiles and Tons											
Fatality Rate	16,300	17,500	23,500	23,700	22,700	25,100	26,400	26,400	24,300	24,800	n.a.
Rate	3.7	3.7	3.8	2.9	2.3	2.7	2.7	2.4	2.3	2.3	n.a.

1. Aircraft and operations data included in Domestic beginning in 1959.

2. Aircraft data not included in 1929.

3. Major line airlines in 1929 included in Passenger Airmiles and Tons.

4. Fatality rate not available.

POST OFFICE PROFIT



ON DOMESTIC AIRMAIL

Fiscal Year	Post Office Subsidy (Domestic Airmail) (1960)	Payment to Airlines for Domestic Airmail Service (1960)	Other Post Office Expenses, Domestic Airmail (1960)	Post Office Profit on Domestic Airmail (1960)
1958	\$ 74,120	\$67,429	\$ 45,883	\$15,967
1959	94,571	41,789	39,634	29,347
1960	106,928	44,304	38,612	17,514
1957	103,189	48,912	91,407	18,647
1956	101,276	41,158	76,940	2,338
1955	123,579	52,571	76,953	2,405
1954	100,517	59,797	81,527	18,993

1. Payments to domestic and U. S. flag international airlines for handling domestic airmail reflect continued United States mail to all states (1954 to 1959); this is a Post Office allowance.

2. Cost of postal services other than air transport of domestic airmail includes extremely small payments to surface carriers for handling air mail and payments to airlines for handling domestic air mail other than airmail.

Source: U. S. Post Office Department, "Carriers' Air Mail Report," for years shown.

AIRCRAFT OWNED AND ON ORDER



By U. S. Scheduled Airline Industry (For Selected Years)

Manufacturer	Model	1929	1949	1952	1954	1959	1960	New aircraft in order for delivery in	1961	1962
Armstrong-Whitworth	Argosy (Transport)	—	—	—	—	—	1	8	—	—
Boeing	240, 244, 317	46	5	—	—	—	—	—	—	—
	8700 (Jet)	—	38	44	24	31	3	—	—	—
	6700 (Jet)	—	—	—	—	—	21	58	11	—
	8700 (Jet)	—	—	—	—	—	—	—	—	40+
Canadair	CL44 (Transport)	—	—	—	—	—	—	—	—	19
Cessna	340	—	112	112	180	44	51	—	—	—
	340	—	—	8	23	123	117	—	—	—
	440	—	—	—	—	36	34	—	—	—
	640 (Transport)	—	—	—	—	3	19	—	—	—
	660 (Jet)	—	—	—	—	—	—	15	30	—
	680 (Jet)	—	—	—	—	—	29	11	—	—
Curtis	C-44	—	2	75	94	94	42	—	—	—
Deagles	OC-2	54	—	—	—	—	—	—	—	—
	OC-3	147	449	419	156	289	334	—	—	—
	OC-4	—	238	186	145	73	82	—	—	—
	OC-5	—	189	175	219	252	361	—	—	—
	OC-7	—	—	—	132	235	317	—	—	—
	OC-8 (Jet)	—	—	—	18	41	14	—	—	—
Fairchild	F-27 (Transport)	—	—	—	—	—	44	—	—	—
Lockheed	L-10	41	6	—	—	—	—	—	—	—
	L-10	11	11	19	—	—	—	—	—	—
	Other early models	6	—	—	—	—	—	—	—	—
	Constellation	—	79	116	117	124	76	—	—	—
	Super Constellation	—	34	79	127	129	—	—	—	—
	Electra (Transport)	—	—	—	—	117	15	—	—	—
Martin	302	—	24	21	23	18	14	—	—	—
	404	—	—	56	97	95	95	—	—	—
Northrop	All Types	28	—	—	—	—	—	—	—	—
Southwest Airlines	Caravelle (Jet)	—	—	—	—	—	—	18	1	—
Wendover	V-200 (Cargo)	—	—	—	56	47	61	—	—	—
	V-200 (Cargo)	—	—	—	—	16	13	—	—	—
	Technique	—	—	—	—	—	—	—	—	—
Other	—	34	10	17	38	16	24	—	—	—
Total Fixed Wing	—	347	1,072	1,303	1,706	1,971	1,863	187	62	—
Helicopters	—	—	—	—	—	—	—	—	—	—
	547	—	4	4	7	5	8	—	—	—
	551	—	5	3	2	2	2	—	—	—
	558	—	—	5	6	5	5	—	—	—
	559	—	—	—	2	6	7	—	—	—
	561 (Turbine)	—	—	—	—	—	—	7	2	—
	562 (Turbine)	—	—	—	—	—	—	—	—	—
	565	—	—	—	—	5	8	—	—	—
	5107 (Turbine)	—	—	—	—	—	—	—	—	—
Total Helicopters	—	11	14	20	23	25	12	7	—	—

1. Scheduled for delivery beginning in 1962.

PERSONNEL EMPLOYED

By the Scheduled Airline
Industry (1950-1959)

Year (See 1)	Flts and Cntrlrs	Offcr Personnel	Passes Stewardess	Cabin Crew	Mechanics	Apparel and Traffic Personnel	Office Employees	All Others	Total
1949	2,379	33	8,834	770	8,413	4,727	3,478	4,391	29,491
1951	2,664	49	12,310	320	4,385	4,951	9,718	1,295	26,488
1952	3,144	241	13,311	1,610	12,882	7,384	11,083	3,204	39,713
1953	3,333	230	17,011	1,701	12,611	8,496	10,679	3,679	44,201
1954	3,246	227	17,054	1,801	12,650	8,746	10,534	4,052	42,407
1955	3,977	894	20,854	2,477	16,940	9,462	21,936	10,446	48,281
1956	7,230	1,103	4,671	6,051	23,176	11,597	31,987	10,446	76,564
1957	6,637	1,233	4,057	3,879	21,149	11,410	32,491	1,016	66,523
1958	4,924	1,016	4,143	3,644	21,818	11,442	31,145	1,279	64,889
1959	4,413	1,002	4,140	3,584	19,626	11,474	30,148	2,070	60,994
1960	7,237	1,021	4,437	3,463	19,664	12,254	31,131	3,188	62,764
1951	4,384	1,268	4,500	3,441	21,477	14,129	35,681	3,813	76,761
1952	5,776	1,852	5,160	3,632	24,142	15,081	33,674	4,124	76,973
1953	6,457	2,194	5,457	4,126	25,856	15,406	40,317	4,988	89,192
1954	6,495	2,325	5,162	3,312	26,175	17,888	40,475	4,118	89,641
1955	10,657	2,742	7,454	2,477	26,975	17,114	48,510	4,371	122,203
1956	11,284	3,084	6,072	2,405	26,842	20,467	47,316	4,076	131,623
1957	13,254	3,797	7,458	2,828	30,342	21,777	57,640	47,158	171,158
1958	12,157	3,667	7,811	2,918	29,880	23,254	55,000	57,948	147,158
1959	14,451	4,036	10,102	3,070	32,813	43,818	53,126	51,344	164,178
1960*	12,484	3,734	12,448	4,211	34,447	44,248	52,624	53,770	164,888

* Data for Alaska and All-Cargo airlines not included prior to 1959

* Preliminary

U.S. AIRLINES' SHARE OF AIR TRAVEL

Between the United States
and Foreign Countries
(Thousands of Passengers)

	1953	1955	1956	1957	1958*	1959*	1960*
Total Passengers in and from U. S.	2,143	3,422	3,194	4,318	5,079	5,794	6,389
By Air	1,074	2,267	1,543	3,052	3,821	4,538	4,898
By Sea	1,069	1,155	1,651	1,266	1,258	1,256	1,491
As Share of Total (Percent)	50.6	66.3	48.0	70.4	75.4	78.4	76.4
All Passengers on U. S.-flag Airlines	818	1,588	1,263	3,811	4,287	3,440	3,925
All Passengers on Foreign-flag Airlines	256	679	490	1,241	1,542	1,899	2,174
U. S.-flag Share of Total Air Passengers (Percent)	74.7	86.3	66.7	67.4	67.7	66.7	71.8

* Includes all land and sea-lanes (except Alaska and Hawaii), oceanic, military personnel and travel between continental United States and its possessions.
* Excludes year figures for 1950-1952 and 1955, based upon Bureau 1950-52

* Preliminary
Source: U. S. Department of Justice, Transportation and Manpower Administration. Report of Passenger Traffic Between the United States and Foreign Countries.

CLASSES OF UNITED STATES COMMERCIAL AIR CARRIERS

There are nine generally recognized classes of operations in the air transport industry of the United States. These classifications are used by the Civil Aeronautics Board in connection with the economic regulation of the industry and under the Federal Aviation Act are based largely on the scope of operations authorized or allowed by the Act. Almost due to seven have conditions of convenience and security authorizing them to conduct regularly scheduled services.

- The Domestic Trunk Lines** include those carriers which presently have permanent operating rights within the continental United States. They are currently trunk lines, most of which operate high-density traffic routes between the principal traffic centers of the United States.
- The Domestic Local Service Lines** have, with one exception, been authorized since 1945. These carriers operate routes of local service between the smaller traffic centers and between these centers and principal centers. The channel local service line in 1959 was:

Allegany Bosman Cortland Franklin	Lake Central Midwest North Central	Omaha Pacific Portland	Southern Trans-Texas West Coast
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- The Intra-Hawaleian Carriers** operate between the several islands comprising the State of Hawaii.
- The Alaskan Carriers** provide service among the continental United States and the State of Alaska and within Alaska.

Operating between continental U. S. and Alaska		Operating within Alaska	
Alaska Northwest*	Pacific Northwest Pan American*	Alaska Alaska Central Bristol Bay*	Kodiak Northwest Pacific Northwest River Western Alaska Wichita

- The Helicopter Carriers** presently operate between airports, coastal port offices, and suburbs of New York, Chicago and Los Angeles. Originally intended as exclusive mail routes they now fly passengers, freight and air express, in addition to U. S. mail.
- The International and Overseas Lines** include all U. S. flag air carriers operating between the United States and foreign countries other than Canada, and over international waters. Some of these carriers conduct operations between foreign countries and some are extensions of domestic trunk lines into Mexico and the Caribbean and to Alaska and Hawaii.

Chicago Helicopter Airways	Los Angeles Airways	New York Airways
Alaska*	Eastern Midwest*	Pan American
Alaska*	Midwest*	Pan American-Group
Alaska*	Northwest Pacific Northwest*	Trans-World Wichita

- The All-Cargo Lines** operate under temporary certificates authorizing scheduled cargo flights between designated points in the U. S. and in one case to the Caribbean and as another to Europe.
- Supplemental Air Carriers** are authorized scheduled domestic charter operations and up to 10 flights per month exclusively related to scheduled between any two domestic points. As of March 1, 1961, there were 31 carriers authorized for this service.

SAFECO American-South American	Flying Tiger Tulsa	Suburban-Wichita Wichita
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- Others.** What might be termed a ninth classification includes a single carrier, Avian Air Transport, Inc., a scheduled four-carrier operation between San Francisco and Santa Catalina.

Among other classes of operations in the air transport industry and air freight forwarding. Air transport operations are regulated through the exemption process and can operate aircraft up to a gross weight of 12,500 pounds. There are 2,614 such units. Air freight forwarding also operates under exemption authority. There are 71 forwarders operating in domestic interstate and foreign and oceanic commerce.

* Seasonal data of these carriers are included with International and Overseas Airlines.
* Conditional seasonal carriers.
* Not operating.
* Confirmed charter carrier.

* Seasonal data of these carriers are included with Alaska Airlines.
* Seasonal data of these carriers are not included in the statistical tables.
* In 1960 CAB authorized the merger of Capital Airlines with United Air Lines.



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MEMBER AIRLINES

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Alaska Central Airlines, D. F. Remick, Co-Manager, 3 Marine Way, Juneau, Alaska
Allegiant Airlines, Lyle G. Bates, President, Washington National Airport, Washington 5, D. C.
American Airlines, C. E. Smith, President, 500 Park Avenue, New York 17, New York
Bonanza Air Lines, Edmund Crossen, President & Chairman of the Board, Post Office Box 101, Las Vegas, Nevada
South Airways, C. E. Reed, President, South Airways Building, Exchange Park, Dallas 15, Texas
Canadian Pacific Air Lines, G. W. G. MacGowan, President, Vancouver Airport, Vancouver 8, B. C., Canada
Com-Maine & North Airlines, Dennis Tegen, President, Post Office Box 1007, Lake Shasta, Shasta, Prince Ritz
Continental Airlines, Keith Koble, President, Army Center Field, Fort Worth, Texas
Chicago Southern Airways, G. W. Young, Executive Vice President, 5310 West 41st Street, Chicago 18 (Illinois)
Continental Air Lines, Robert P. Orr, President, Hughes Airport, Denver 7, Colorado
Delta Air Lines, C. E. Williams, President & General Manager, Atlanta Airport, Atlanta, Georgia
Eastern Air Lines, E. F. Eichenlaub, Chairman of the Board, 18 Boulevard Place, New York 20, New York
Elm Air Lines, E. S. Ellis, President & General Manager, Post Office Box 1070, Kalamazoo, Michigan
The Flying Tiger Line, Robert W. Pinner, President, Lockheed Air Terminal, Burbank, California
Frontier Airlines, G. B. Rogers, Jr., President, Hughes Airport, Denver 7, Colorado
Horizon Airlines, A. D. Lewis, President & Chief Executive Officer, Hawthorne International Airport, Post Office Box 1207, Hawthorne 17, Florida
Jetco General Airlines, Gary Higley, President, Fort Worth Municipal Airport, Indianapolis 21, Indiana
Los Angeles Airways, C. M. Ebeling, President, Box 41219, Airports Station, Los Angeles 41, California
Major Airlines, J. C. Miller, President, Edward County International Airport, 4102 S.W. 11th Avenue, Fort Lauderdale, Florida
Midwest Airlines, Robert F. Frank, President, DuPage County Airport, Evanston, New York
National Airlines, G. E. Baker, President, Post Office Box 114, Airport Road, Oakley, Missouri 59, Florida
New York Airways, Keith C. Cummings, Jr., President, Post Office Box 630, LaGuardia Airport Station, Flushing 71, New York
North Central Airlines, Hal N. Carr, President & General Manager, 1201 15th Avenue South, Minneapolis 31, Minnesota
Northwest Airlines, Louis F. Berke, President & General Manager, Logan International Airport, Boston 26, Massachusetts
Northwest Consolidated Airlines, Raymond J. Patterson, President & General Manager, 411 Fourth Avenue, Anchorage, Alaska
Northwest Airlines, D. W. Nye, Vice President, Post Office Box 1, Seattle 1, Washington
Quick Air Lines, J. M. McQuinn, President, Box 6007, Lambert Field, St. Louis 14, Missouri
South Air Lines, John W. Connolly, President, San Francisco International Airport, San Francisco, California
Southern Airlines, G. W. Williams, President, 600 North Washington, 600 North Washington, Seattle 1, Washington
Tex American Airways, Andrew B. Shaw, President, 151 East 41st Street, New York 17, New York
Tex American World Airways, J. T. Trotter, President, 151 East 41st Street, New York 17, New York
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Western Airlines, Robert C. Rorer, President & Superintendent of Operations, Box 792, Anchorage, Alaska
Western Airlines, E. B. Wilson, Chairman of the Board & Chief Executive Officer, Post Office Box 154, Alameda, California
Western Airlines, Robert J. Mory, President, Post Office Box 115, Alameda International Airport, Fremont, Alameda 11, Florida
Western & Western Airlines, Richard M. Jackson, President & Chairman of the Board, Oakland & Western Building, New York International Airport, Jamaica 30, New York
Western Airways, Frank P. Hahn, President, 191 Route 66, East Bay, Birmingham, Alabama
Trans-Canada Air Lines, G. Gordon Wood, Vice President & Sales, International Airlines Building, 1001 University Street, Montreal 5, Quebec, Canada
Trans-Canada Airways, G. Ray Clark, President, 171 Park Avenue, New York 22, New York
Transwestern Airways, E. E. McKee, President, Suite 811, Texas Eastern Building, Houston 2, Texas
Trans World Air Lines, Edward Lee Potts, President, 160 Madison Avenue, New York 17, New York
United Air Lines, W. A. Patterson, President, 3015 South Green Avenue, Chicago 34, Illinois
West Coast Airlines, Fred Ross, President, 1330 Divisor Highway, Seattle 4, Washington
Western Air Lines, T. C. Donahue, President, Post Office Box 90, 601 Airport Square, Los Angeles 45, California
West Atlantic Airlines, David W. Pinner, President & General Manager, Box 549, Fairbanks, Alaska

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**NORTHEAST
AIRLINES**

Supersonic Designs Cover Wide Spectrum

By David A. Anderson

**For the "Hustler":
High Speed Bomb-Nav
Checkout System**



A new, high speed automatic checkout system developed for Convair by Sperry can make up to 3,600 different line checks on the complex bomb-nav system of the B-57 Hustler, most of which require only 4 seconds to set and complete.

In a mode on Flight Line Tester coupled to the B-57, the AGIE (Automatic Ground Equipment) performs desired checks which are programmed by punched tape. Visual "go, no-go" read-out is provided. In event of malfunctions,

additional rapid automatic rechecks can be made in repair-shop installed set-up to prevent line trouble.

The advanced system is now undergoing final Air Force evaluation at Convair AFB. Significantly faster than conventional check-out methods, the highly efficient Sperry AGIE system also improves the accuracy, simplicity and flexibility of testing.

The Sperry-developed bomb-nav assignment system has contributed sig-

nificantly to the newly operational Hustler, which won the SAC trophy for both low and high altitude bombing in 1963, with only 4 weeks of operational training for its crew.

SPERRY

AIR ARMAMENT DIVISION, SPERRY SYSCOPE COMPANY, DIVISION OF SPERRY RAND CORPORATION, GREAT NECK, NEW YORK

At last night's supersonic intercept design are beginning to take shape on agencies' drawing boards in the United States, Great Britain and France.

Scheduled for above speeds in the early 1970s, these new transports will be operating in a flight regime called a quantum jump ahead of anything ever attempted in aviation.

Present cruise speeds vary from Mach 2 to 5, with some suggestions that 15 is not out of the line. Cruise altitudes would start at levels of 50,000 ft or more above the operational ceilings of today's jet transports, in the 60,000 to 75,000 ft range.

Range may reach 1,500 mi. or to 3,500 mi. and jet transport capacity is as low as 70 seats in some designs, as high as 140 in others. Classification shows the wide variety of the world's present jet transports will be operating at advanced transportation rates possible to today's afterburning military jets.

Yet the state of the art will have advanced in the next decade to the point where, designers are in complete agreement, what quantities will be possible and in what cases, extremely profitable.

National Issues

Supersonic jet transports fall into two basic categories: Mach 2 or slightly higher cruise speed, and Mach 4 or slightly higher. Advances in the latter are the British and French, the Americans hold the latter view.

Effort also can plot course of performance parameters, weight, power required, seat boom strength, cost and so on after fairly reasonable and more up-to-date knowledge in the choice of Mach number is used. These solutions to engineering questions depend largely on the proper choice of control mechanisms.

The British and some Americans believe that the American choice of Mach 3 was an early, competitive move, made shortly after North American Aviation announced its intent of building a supersonic transport based on the B-70 Mach 3 bomber. Many Americans believe that the British are stuck with the lower Mach number because their atmosphere knowledge doesn't permit a higher one.

One interesting phase of the effort is that spokesmen for the British seem to spend a large part of their time settling the choice of Mach 2 or 3, and finalizing the U. S. perceptions with Mach 3.

Everything from technical arguments to questions from Shakespeare ("You say too late, it spends too late, 'twill take long") takes 1000 hours in fact involved into the state of technical preparations by the British, but the effectiveness of the arguments seems to favor it a few feet.

General feeling is that competition will force the best and subsequent soundly of purposes, just as it did in the subsonic jets.

If the initial order goes to shape up around Mach 3, then a Mach 2 transport has little chance of being bought outside its own country.

The Art Advances

These proposals are not technical matters, but engineering problems. They represent some consideration of the problems by the two world's top design teams, airlines, government agencies and engineering organizations. The question is no longer "Will there be a supersonic transport," but rather, "When will someone agree to start?"

Obviously the biggest impact in the art has been the B-70 competition, not only for work of the U. S. community, and now by North American Aviation. Role reformation data, developed by the then National Advisory Committee for Aeronautics, now the National Aeronautics and Space Administration, has been fed into the project team of all the responses involved. The development of a new kind of personnel was also developed to cope with all afterburner power-loads critical to the design. Structural methods, control laws, efficiency, systems development and other things, transport-off-the-line in great measure the preliminary B-70.

North America's first configuration for a supersonic transport was feasible that of the B-70. But there have been changes in the state of the art ever since that sophisticated level was designed, and today the B-70 plan is regarded as obsolete for some reasons, including those relating to North America's supersonic transport program.

Some of these advances have come from NASA, others from the companies' reconfiguration in mind towards their own or other agencies. One interesting phase, and perhaps the most controversial, has been the concept of variable wing.

At low speeds, where wing aspect ratio is a major factor in determining lift performance, the wings are spread to their maximum span and aspect ratio of 8 to 12. For takeoff, approach and landing, they provide one in banking patterns, the high aspect ratio wing offers the greatest maneuverability.

But, first at high supersonic speeds, the wings can be folded off to reduce the wing aspect ratio to 2 or 3. The wing goes down rearwardly, and the thrust acquired between more reasonable.

Noted strongly by NASA, the idea of variable wing has been regarded with increased care by aircraft designers. The main complaint is that the mechanical joints are too heavy, too bulky, and would present new maintenance problems in the airframe. These claims at the end may result in the other extreme variable but unusable space.

And companies have wondered if they would have to reinforce the airplane for the loading conditions with its wings in the cruise attitude.

NASA considers some of these arguments, and admits that its studies are not prepared for enough to get into the design process. In the meantime, at cruise performance and weight penalties.

But preliminary wing joint have been built and tested under load for NASA, in design applicable to a large range of lift, and have proven their mechanical points.

The powerplant at last advanced in greatly during the past 10 years, but again some can look at a choice of at least four have major cycle, with several times suggested for each cycle. At this stage, most designers agree to face the turboprop engine, with or without dual burning (AWJ July 11, 1963, p. 96). But one advocate says that the first closure of the engine cycle can start with next year. Further advances may be before March 31. Progress may be possible in that time.

Both General Electric and Pratt & Whitney Aircraft are currently running advanced components in bench tests to prove their worth for the engines of the next decade. Among these are parts which will be directly applicable to the

March 3 automated course requirement of the supersonic transport.

Both companies have contracts for Mach 3 engines, and have two major studies on them. Both companies have tested engines at that speed. Pratt & Whitney says it has 100 ft. running tests at simulated Mach 3 inlet conditions and 1,900 ft. test test time, on the J58 engine. The company also plans to 30,000 ft. test on two engines for the engine, plus other hundreds of hours in which and exhaust studies with suitable guarantees.

General Electric has been quite specific, but obviously has been more sure than this in its development program at the J58 subsonic engine for the B-70 program.

A data home in the post-plant program is North American's 11-11, which has received a study contract from USAF for a Mach 3 prototype using a turbofan engine mounted in the central case of a nacelle. Variable geometry of inlet is used.

Part and parcel of the post-plant evaluation is the air intake and exhaust system. Now, before an aircraft design has been so excited for the engine and airframe to be matched as feasible. Poor performance of the engine must be maintained over a range of conditions from static thrust at the start of the climb run through the

takeoff acceleration to supersonic cruise.

Moving these varied requirements, one must be done with great precision on static and takeoff, with special care to control the position of the shock wave when in the establishment of supersonic flight and a variety of other devices, such as variable peak position, of the inlet mass.

Structural approach will have to be different, too. The internal test bases, mostly static, partly powered for the B-70 will be adapted in some of the manufacturers of O-5 transports.

Tolerance pressure structure will come into its own. But transport will have to be subjected carefully, because certification design means working to lower stress levels because of the increased effects of long-time test loading on those materials.

Jetstream design will call for new methods, on static and dynamic, new fluids for hydraulic tests operating at 5000 to 10,000 ft. Cabin conditioning without will be working under higher pressure differentials than ever before, will be required to filter out or exclude the noise in the high-altitude cabin.

There is complete agreement among designers that the job is technically feasible, the uncertainty is, as we know or understand the problem. Some

of them may be of a timer nature, but most of them are still the difference between possible or impossible open time.

Operational factors will present a whole new bag of tricks to the airlines. Takeoffs at one end of the flight, and approach and landings at the other, will continue to be non-problem, in that of today's subsonic jet transports. Ground handling, passenger handling, ramp parking, towing and towing will be the problems of the order of magnitude, they are today. About without exception, the manufacturers agreed that today's airports and runway lengths, their ramp and taxiway and strength, would have to be met for the design of their handling gear and specifications of their transport's taxiing data.

New approaches in flight will be in the supersonic range and will affect almost every established routine. Radar and radio means will have to increase in an order of magnitude. VOR stations every 150 mi. will be flown out of the rate of air over the oceans, leaving little time to deal frequencies. Flight planning and scheduling will be affected in the disturbance, not in the design, of the same home. Furthermore, one look, there is a new kind of operational problem.

But the biggest uncertainty today

and therefore the biggest problem facing the designers tomorrow, is the acoustic boom. It is more that this factor, almost completely out of the control of the designers, may finally determine in large measure the operational design of the supersonic transport. Magnitude of the problem is enormous, as fact says NASA, it is the most order of magnitude as the problem of safety in supersonic flight.

There is a small, but varied, school of thought which says that some home—just like air induction design—has no work, and that therefore there can be no supersonic transport. But the majority view, shared by engineers and scientists is that the problem can be solved. Each side also makes a case of reasons and arguments in support of its view.

The only fact about the most home is in controversy, any further data quoted is either observation or very limited experimental results. The theory based on work done in British universities. Dr. Gerald Whitman about 10 years ago, generally is considered by available test results, except that it tends to calculate noise levels on the potential side.

Experimental data points come from flight tests of supersonic airplanes, and show considerable scatter, as much as 10% above, and more below, the average law. Furthermore, the observed local noise varies with topography, weather and distance.

There are two theories, which are the strength of supersonic shock waves and (thereby) the amount of the noise from the bow wave, or more shock, generally a function of the formation rate of the shock and the wing shock within a function of the angle of attack.

Noise shock produces the "sonic boom," the major component of noise heard from supersonic aircraft. We also predict the "lift boom," which gets stronger as the replace altitude increases, because the wing is able to attack, encounter in maximum lift. As altitude increases, the lift boom becomes the controlling portion of noise intensity. This is why test data from small air planes at lower altitude does not apply directly to the supersonic transport.

The magnitude of the noise of some home is defined in terms of frequency at the ground—the amount of increase in the sound atmosphere pressure caused when the shock wave originates from a disturbance passes the observer.

The typical and familiar sound used for comparison is distant thunder, which produces an increase of about 1 psi. Double this value is enough pressure to cause minor damage, to break large, poorly supported windows and to provide storms of public reaction.

One threshold of physical pain is 1 psi.

Most designers of supersonic transports agree the ensuing sonic boom of their aircraft will approach to about 1.5 psi at sea level on the ground, and feel that figure is the maximum tolerable value. That would be produced by a typical Mach 3 transport at 60,000 ft., or a Mach 4 plane at 75,000 ft.

Calculations show that maximum strength of the observed sonic boom on the ground occurs somewhere around Mach 1.5 above that speed, and noise effects have little effect at constant altitude. Such Mach numbers are reached during climb below 40,000 ft. in most

of the flight paths proposed for supersonic transports; corresponding measurements on the ground might be as high as 1 psi, on an altitude level.

To add to the disturbance, the sonic boom occurs over a swath on the ground below the flight path. Typical "noise carpet" width could be as high as 100 mi. Locally, swarms of people live on the future "noise carpet" of the high-speed domestic U.S. routes.

Serious educational pressure has been laid in some quarters at solving the noise boom problem, generally in areas where military operations were taking place, and public response was confident. But no amount of education



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Blue noise checks out sound waves are housed through honeycomb panels under water in impact testing.



Mach 3 Manufacturing

Sounding out the inner secrets of brazed honeycomb panels

Manned aircraft are built with bonded panels of stainless steel honeycomb in order to fly at speeds of supersonic speeds. But inspection of these panels becomes a major problem because the interior of bonded honeycomb panels cannot be seen.

To solve this problem in designing the Air Force's new B-70 Valkyrie airplane, a special Quality Control Development Program was undertaken at the Los Angeles Division of North American Aviation.

The results show that inspection, a process that works like the Navy's sonar system for locating submarines by bouncing each finished panel into a tank of water and

then transcribing a sounding head over it, sound waves are transmitted into the panel and reflected back to the sounding head. The reflections are recorded on photosensitive paper for a permanent record of every square inch where honeycombs and skin are bonded together. Any area that has been improperly bonded will show up instantly.

This method of inspection is just one of the many programs and techniques in Mach 3 manufacturing that have been created by North American development programs. Other advances cover the full spectrum of single source fabrication. As a result of these programs, North American Aviation has met the challenge of Mach 3 manufacturing.

Builders of the B-70 Valkyrie

THE LOS ANGELES DIVISION OF NORTH AMERICAN AVIATION, INC.



gets taken used to the idea of subtle developments and the sonic boom of supersonic transport would almost make them up.

Answerer is also proportional to the number of times the airwaves occur. However, design will get up with an accurate understanding that noise levels, but the frequency of some booms could be several per hour, right after night, only the most phlegmatic passengers and sound sleepers would be able to tolerate such disturbances.

Next arrival at airport is early, cramped, about, on peak, up the phone and make a local call. But when does the disturbed sleeper in Concord Mall call at those o'clock in the morning?

Educational Programs

Educational programs also serve as other large segments of the living paper. These, solid and domestic animals. Red learn have based education of industry, safety in the United Kingdom, roads, machines and safety, drivers have been expensive design notes against the military and against civil aviation. Concorde at D. Wank, Tex., there is how taught a large number of the children from start of its flight as a study of B-54 flight operations.

The major difficulty in the way of solving the sonic boom problem was the lack of extremely, single test data from large aircraft. Supersonic fighters or the light B-54 do not generate strong enough shock waves to compare with those that supersonic transport will produce.

But in a first step, flight tests of the B-54 are being made as a joint program designated "Little Boon" and being run by FAA, NASA and USAF. Data on the lower boom intensity of large airplanes will have to wait until sometime after the North American B-70 has entered flight tests. Perhaps two or three years from now will have to pass before enough knowledge has accumulated.

At that time designers will be able to understand the real problem and will then be able to work toward a real solution.

Boom Reduction

There is some indication that favorable interference of one shock wave on another, caused by the geometry of the airplane, might reduce the boom intensity. Some estimates show this reduction will be on the order of 15%; arguments agree it may that shock reduction will be far off, considering that it might change the layout or volume of the airplane.

Redesigning the flight path of supersonic transport could reduce the worst boom problem by delaying acceleration through some speed to reach at Mach

1. If higher altitudes were used for that acceleration it would require a higher requirement on engines. Extra thrust needed for acceleration decreases as altitude increases, the only way to put this in design would then capability into the engine, at the cost of increased fuel consumption.

Finally, the sonic boom problem can be avoided completely by flying subsonic over populated areas and accelerating and crossing supersonically only above uninhabited or ocean areas. This, according to some engineers, could do just the trick, perhaps of the expense however. At best, it might mean an 80% increase in direct operating cost due to the inefficiency of off-design flight. The prospective total airplane weight would drop as much as 50% because of the lower demand for materials restricted to those operating at subsonic.

And the lower market would be two areas at increased initial cost to the customer.

A Concorde spokesman said his company wouldn't undertake the design of a supersonic transport unless it knew the answer to the problem of the sonic boom.

The fact remains that supersonic transports are being designed, that com-

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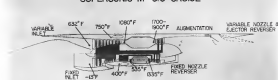


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COMPARATIVE cross-sections of Mach 3 and subsonic design-point jet engines, here illustrated by Pratt & Whitney Aircraft Division, United Aircraft Corp., examples show that basic engine proportions are not affected by the low rise in flight speed. But external geometry of the inlet and exhaust systems shows major differences between the two types.

panies have project teams in existence, and that sizable sums of money are being spent right now, in the United States, England and France on the development of an airplane whose future appears to be fundamentally both certain and unknown.

This is the current status of projects for which some data is available.

Beeing's Approach

Conquest engineers emphasize that current Boeing thinking on the supersonic transport is flexible, and that any specific configurations has not yet been decided. Groups of basic design in most a varied set of requirements have been developed, and they then certain figures in common.

At this stage, Boeing thinking centers around a cruise Mach number below 3, heavily stated by the company as 2.5 to 3, but probably settling on at 2.7. Corresponding cruise altitude would be 60,000 to 65,000 ft.

Typical design study for a 140-150 passenger supersonic transport shows a takeoff gross weight of about 400,000 to 450,000 lb. Aerodynamic layout is not fixed, but probably would develop into a conventional configuration, using wingtip folding and variable geometry of engine inlets. Either folded or clamshell powerplants could be used, says the engineers.

Takeoff speed would approximate 150 kt, and landing speeds would be on the order of 145 kt.

Baseline load factor used in design is 30G, and test studies show direct operating costs to be comparable or a few mills higher than those of

current subsonic jets in operation. Design goals for refinement and improvement are 10 years.

As a result of its B-47, B-52, T-70 and KC-135 programs, Boeing has more jet experience than any other group in the world. The importance of the background has not been overlooked, either by the company or by its competitors. But while the total design budget are enormous, sums on individual aircraft are not that repetitive.

One engineer made a quick estimate that the high-speed jet bomber would only show a overall inflation rate of about 3,000 hr, and added that Pan American's high-speed jet probably had about 3,000 hr already. That, he emphasized, was a long way from knowing anything about an airplane at 30,000 hr.

First cost of the supersonic transport is nebulous at this stage, says the company, but it would be somewhere between \$10 million and \$20 million per airplane depending on the overall outlet and many other factors. One estimate of the project cost was about \$1.5 billion, a \$50 million, which represents about twice the money in 1961 dollars invested in the development of the T-70 prototype.

Financially, Boeing enjoys a major advantage in the jet transport business because of the success of the T-70 program. Most of the competing companies believe not only that Boeing could finance the program alone, but also knew that it might not. The company's stand on free enterprise is well

known in the industry, and Boeing officials have said that the low government influence in the supersonic program, the latter it will be for everybody.

Current thinking by Conquest Division of General Dynamics on the supersonic transport evolved from systematic studies begun in 1954 and continuing today. Conquest's market survey report, widely regarded as an outstanding effort in defining goals for the supersonic transport program, cites 124 possibilities in its lists, including 16 separate aircraft configurations. These were analyzed for three ranges, four speeds and three sizes. Three profit levels for the supersonic were considered, at was the probability of having one, two or three manufacturers participating in the program.

Conquest proposal now under consideration shows a delta canard layout with an turbofan engines mounted in a canard cluster underneath the wing. Takeoff weight is estimated at 600,000 lb. Wingspan is 82 ft., fuselage overall length is 167 ft., and maximum height in three-point attitude is 46 ft. Design cruise speed now is established at Mach 3, says the company, but settled recently, this literature talked over the range between Mach 2 and 3. Cruise altitude would be up to 75,000 ft. Takeoff speed is estimated at 175 kt, and landing would be between 140 and 145 kt.

Costs being in provided for 130 people in a fuselage diameter comparable to today's Conquest 584 wide-body jet transport.

In contrast with other consider-



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hairs. Casser is flying on a design innovation load factor of 30G. Using that figure, a quarter-ton mid-size aircraft carrying only a half-tonner than today's subsonic jet transports, presumably its own.

Design life of the engine has been cited as 52,000 hr or that they will be able to generate 30,000 hp to the vehicle customer. Airframe structure would be steel and titanium, probably in the B-70 manner with bonded honeycomb structure where there are combinations of high loads and bending, and with the remainder of the structure mated titanium skin and stronger construction.

The company says that the initial aircraft contract required to get a supercruise engine into the air would be on the order of \$200 million, representing 100,000 sq ft of aircraft and 100,000 sq ft of engine.

In spite of the company's long experience with supersonic flight, General is the first to point to a subsonic as a benchmark of what the flight team really means. The B-70, it says, in November, 1956, and evolved as a flight-test program of 30 aircraft, but lagged about 100 hr of time about March 15. This is out of a total of about 10,000 hr time on the flight-test program. Flight time at or above Mach 2 is far less.

The B-59 is the only current airplane capable of sustained supersonic flight for useful periods of time. Even so, the longest duration of Mach 2 flight with the Hustler has been a little more than one hour on a run from Seattle, Wash. to Waco, Tex.

General's belief is that the best approach to a program is to establish an interim supersonic transport based on the B-59C configuration, powered by four Pratt & Whitney T55 engines, and now slated for use flight vehicle (AW Nov. 14, p. 54). A dozen of these airplanes entered through development and flight test, could produce 10,000 hr of experience above Mach 1.5 by 1967, says the company, for a cost approaching \$240 million.

Even though General stands to benefit financially from such a program, other companies have expressed apprehension of such an approach. They feel that such a vehicle and the B-70, working in under public relations, could open and fast all decade runs of the technical arguments over the wing boom, the costs and value of Mach 2 by March 5, the Pratt & Whitney T55 against the General Electric T55 engine cycles and operation, and when a host of other problems in economics, equipment, hardware and electrical systems, navigation, traffic control and others.

Maintaining an attitude similar to Boeing's, Douglas Aircraft engineers say it is much too early to specify details of



India's Hindustan 24 to Fly This Year

India's first supersonic fighter—the Hindustan 24—already has completed preliminary ground tests and is scheduled to fly later this year. The aircraft, designed and built at Hindustan Aeronautics Limited, Bangalore, India, is expected to be at Mach 2. India's Defense Minister Krishna Menon (shown here) is seen inspecting the aircraft.

a supersonic transport geared to serve outside of the early 1970s. Furthermore, studies have started down the field of work, they say, but final answers are still some way off.

Result of the study program will be dependent on what the customer wants, says the company. Meanwhile, they have been working on a Mach 3 airplane proposal with a range of probably 1,000 miles or more, although the figure may be revised upward to meet customer preferences.

Lavate of the aircraft is a delta conical, with either four or six turbofan engines probably, mounted in a center line cluster underneath the wing. Studies cover the unit range from 70 to 160 passengers with the smaller transports carrying a maximum of 250,000 lbs at 14,000 ft and burning up to 10,000 lb of fuel in 10 hr. Wing span is between 70 and 120 ft in the Douglas studies. Overall length is between 150 and 200 ft, and maximum three-point height is 75 to 95 ft.

No performance figure for takeoff approach and landing regimes are now available, but Douglas says its future airplanes will operate out of main's airports with normal runway lengths.

Direct operating costs will be low enough to make possible profits will show current levels the company is seeking. Part one to the customer would be between \$10 million and \$75 million per airplane.

Airframe will be built of steel honeycomb sandwich and titanium skin and stronger construction. Program development costs could be between \$500 million and \$1 billion.

According to Douglas estimates, the company says the Mach 3 program represented a \$400-million investment in a comparison. They expect that 1915 million engineering man hours will be required to handle the study, design and development of the supersonic transport.

Lockheed Aircraft

Seventy studies by Lockheed date back about 25 years and have been estimated at the rate of about \$1 million per year. A large share of this money has been spent in detailed wind tunnel configurations studies of basic design features such as wing geometry, flight station geometry and the placement and design of nacelle inlets.

The company has ruled out any Mach number below 1, preferring to make the Mach 3 transport now and plan for possible stretch to Mach 3.5 in the future. Range is the standard 1,600 miles per hour.

Lavate of the Lockheed supersonic transport is not yet final, a quality it shares with other manufacturers' studies. But it still probably shows the benefits of the revised wing-plan, with variable geometry, as engine inlet and possible wingtips. It can have a wing application of variable geometry in the forewing area which is not shown as all center point to provide greater operational flexibility for the right over to the takeoff approach and landing regimes.

Engines will be four duct-burner turbofan powerplants, clustered in a single nacelle underneath rear fuselage. Forward fold length for the Lockheed design would be about 100 ft.

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the 30,000-ft ceiling proposed in the FAA. The company proposes to guarantee hot-day operations from such extremes.

Specific sizes and weights are not yet defined by Lockheed, but it does say takeoff wing loadings will be on the order of 70 psf and landing loadings will be between 60 and 65 psf.

While general statements by the company show direct operating costs competitive to those of current subsonic jet transports, one spokesman said privately that calculations for Mach 3 show that an engine can make really large profits with the Lockheed proposal, large enough to rule out any consideration of lower speeds.

Calculations of direct operating costs were made with slightly higher break-even load factors than those used by other manufacturers. Lockheed studies showed 52 to 55% break-even load factors. The company estimates the present world rule might soon have given rise to certification of the first aircraft.

One major area of disagreement with other manufacturers is in the proposed structural analysis of the supersonic transport. Lockheed believes that the stinger construction in steel and titanium has advantages which outweigh the use of the greatly lighter bonded honeycomb sandwich construction. Major disadvantages cited for the steel wing structure are the difficulties of inspection and maintenance and the higher development and manufacturing costs.

Lockheed contends that sandwich structure strength and fatigue characteristics are possible structural superior to the steel-stinger alternative.

Santhosh construction is still being used for structures where load competencies and uncertainties are required with minimum gross principal stress and deflection, a key loading factor would be heavy cross panels.

North American Aviation

First government in the supersonic transport bid was publicly started by North American B-70 contract. The transducers, pneumatic stresses and stresses of that airplane were seen as qualitative in large measure due to the design of a supersonic transport.

The B-70 is being designed to cruise at Mach 3. The initial wing from that design is in a supersonic transport with the same wing speed. Over North American made the decision to go for a supersonic transport after manufacturer was not faced with meeting the same cost Mach number. That means other than cost of supersonic transport, it would be believed to be the major one behind U.S. industry's agreement on Mach 3 cruise flight.



Grumman A2F-1 Carries 15,000-lb. Bomb Load

Ground report ability with sea and shore attack is demonstrated by Grumman A2F-1 Navy attack aircraft carrying three 100-lb. bombs. The carrier aircraft carries three in its fuselage and one on its belly station.

But North American has proposed beyond the soundness of the B-70 while showing its air transport performance. Then current configuration studies still center around a curved delta geometry with leading edges and visible geometry on the outer edges.

But the wing is now a shortening wing, where that of the B-70 was a low wing layout. And the engine exhaust under the fuselage on the B-70 are separated now on each side of the leading, tucked in under the fuselage under the wing root is what Lockheed has independently called the "array" configuration.

Projections right now are in the low 100 with state thrust of 30,000 lb. each. These will be based primarily on the General Electric J91, but some these engines were designed in afterburning mode. These engines can be changed made for the supersonic transport in the interests of fuel economy.

North American design of the North American can will also feature lower airframe control on wing tips and leading edges, as well as on engine door seals to improve their efficiency.

Company design already calls for the engine cycle to be selected in its fuel flow during sea and land, and for configuration selection in 1965. North American talks in terms of the early 1970s as date of entry into service.

Basic proposal now current in North America shows a Mach 3 cruise speed at 70,000 ft over a range of 1,500 mi. Steering capacity will be 180 to 190 degrees.

Under the maximum from 30,000-ft runway, some design requirements for

the low speed flight range. Estimates of initial speed can range 180 to 190 ft, with approach speeds between 130 and 140 ft.

Tallord gross weight of the North American proposal is 450,000 lb. Weight is an area 180 ft, wing 120 ft, length a 105 ft and fuselage height is 32 ft.

Construction will be like that of the B-70, with bonded sandwich sandwich structure in hot, low-speed areas. Single-skinned riveted titanium skin-and-stinger construction will be used for landing and other sections.

Quoting an initial cost of \$18 million per airplane not including spares, North American shows direct operating costs at a level which would not be quite as high as it is, but some of these figures are based on the fact that direct operating cost estimates are necessarily quite vague at the stage of the design, and that it's all a question of breakdowns and just now.

British Aircraft Corp. has been making the considerable mechanical details of Bristol Aircraft Ltd., English Electric and Vickers Armstrong, (Aircraft Ltd.) has been in the design of a 120-passenger supersonic transport. The smaller, lighter version is planned to operate over a 5,000 mi. air strip, at a Mach 2.3 speed.

Details of the design have not been specified, but the ground configuration has been stated to be a narrow delta wing form, with a clustered engine area and possibly the use of wingtip folding to increase structural stability at high speed and speed at low speed.

Tallord weight of the British Aircraft Corp. proposal is currently cited

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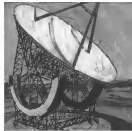
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TWO-IN-ONE TARGET DRONE. New target drone NA-875 can carry out high- or low-level missions equally well. It performs from ground level to 60,000 feet, and from subsonic through Mach 2. Under development for the Army by the Columbus Division, it is launched by a rocket, and powered in flight by rocket.



ASV VIGILANTE. Navy's ASV got a new world's record, flying to 50,000 ft. carrying a payload of 2,000 lbs. The versatile, carrier-based ASV can perform high or low level missions in any weather, from any altitude, day or night.



THE BIG "EAR." World's largest radio telescope reflector, six hundred feet in diameter, is being built by Columbus for the Navy in Sugar Grove, W. Virginia. Columbus is also building a complete antenna system for the USSR.



VISUAL FACILITIES. New six-degree-of-freedom flight simulator is part of facilities set up by Columbus Division to study requirements of vertical and short takeoff and landing aircraft design and development. Other systems facilities include low-speed to transonic wind tunnel and unique lightweight ejection seat.

at 137,000 lb., with empty weight down around 152,000 lb.

Takeoff speed is estimated at 180 to 190 km., and landing speed at 135 km. Construction of the airplane will be conventional aluminum alloy skin and stringer type.

Huckel-Buddler Austin, leader of the two British contractors in terms of engineering strength and facilities, has related little is nothing on its work as supersonic transport. It is not possible to envision this aircraft organization straggling out of the market, so that will be more than Mach well along on progress for a Mach 2 to 2.4 aircraft of roughly the same size and weight range as the BAC entry.

Experience of the group includes much logged flight time with two large multi-engine aircraft, both civil and military Avro Vulcan bomber and de Havilland Comet transport series. Supersonic flight experience is limited in the group, none of its aircraft is capable of supersonic level flight, and the logged time above Mach 1 is in the very low supersonic range and probably totals less than one hour.

The French team of Sud-Ouest, backed by government interest and some funds, is collaborating as a manufacturing supersonic transport which may in effect be a Mach 2 Canard.

Sud-Aviation, series member, says, acquires the major portion of the entire French aircraft industry. Its best known products are the Canards and the Aerospatiale helicopter. Background experience includes some work with supersonic interceptors — Trident and Dassault.

Canards Aerodynamique Marcel Dassault holds a new concept in French fighter design and in that position also on most of the supersonic business in French airplanes. The company is aggressive and technically acquainted outside of France.

The team envisions a 70 to 76 passenger transport cruising at Mach 2 to 2.2 at an altitude of about 60,000 ft. Design range is 1,000 miles or so.

The configuration chosen has an arrow to two conventional canards with delta-wing aft, or the so-called "Gothic" or "Dag" wing which takes its name from the S-shaped shape of its leading edge. Four tailbooster engines are planned, perhaps using disturbance for sustentation phase of flight. There will be variable geometry on the engine inlets, not on the wing.

Gross weight at takeoff is estimated between 155,000 and 170,000 lb. Conventional construction is planned. Canards canards and report facilities are being set in standards for his development of the transport.

Operational costs are estimated to be comparable to those of the Canard.

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PRODUCTION BRIEFING

Watchdog Mfg. Division of the Benet Corp., Wood Dale, Ill., has been awarded contracts in excess of \$1.25 million by both the Navy and the Air Force for guided missile launching equipment. Requirements include modification or replacement of electronic equipment applicable to both infrared and radio seeking Self-Defense missiles.

144 Electronic, Inc., will develop a precision oscillator for the radio launch control system of the Mountainview Electronics System Division of Sylva Electronics Products, Inc. awarded the \$284,000 contract.

Ionospheric Research Laboratory at Fort State Monmouth has been awarded a \$25,500 NASA study grant to investigate the feasibility of using a radio-frequency radar system to measure electron densities in the upper atmosphere. If the method proves feasible, Fort State is expected to request NASA sponsorship of a series of experiments probably with the Javelin high altitude rocket.

Trane Electronic Corp., a unit of Union Carbide Corp., has signed a new purchase contract with the Atomic Energy Commission to provide the government with sodium concentrators valued at \$20,799,000 over a period extending from Jan. 1, 1963 through December 1966. The new agreement replaces an old contract that would have expired Nov. 31, 1963.

Boeing Mfg. Co. has been awarded a \$280,000 Air Force contract for design and construction of high altitude research centers in N-15 aircraft. Program will be conducted partly by Boeing and North American Aviation and will include construction and installation of two large ground control towers at the Mogus Desert.

Island Industries, Inc., has received an Air Force contract for more than \$1.5 million for advanced development and production engineering of advanced Avionics for M-16s.

General Dynamics Electronic has been awarded a \$497,650 Air Force contract to provide UHF and single channel radio equipment for aerial program command and control three-fives.

American Optical Co., J. W. Foster Division has been awarded an \$838,720 Army contract for delivery of 12 gimbal-mounted telescopic tracking extraradars to White Sands Missile Range, New Mexico.

East Armament Co.'s Aerospace Division has awarded a \$1.5 million contract from the Air Force to provide 310 Q-2C Redback target missiles for the South West Air Force. Most improvements to the missile will include an automatic fuel phasing system and MAVTS (multiple air target system) among others and electronic signal indicators for fuel gas tank and antenna position.

AC Spark Plug Division of General Motors has received a \$1,282,195 Air Force contract for platinum electrode spark plugs to be installed on C-124 aircraft.

Traverse Recharge Manufacturing-Lincoln has secured a \$134,784 contract from the Navy to manufacture 16 air particle counters to be installed on nuclear vessels. The counters provide visual and audio signals when radioactive reaches threshold levels.

Baldwin-Lewis-Henderson Corp., is General Equipment Division has signed a contract with North American Aviation for just under \$110,000 to manufacture a 1440 diameter ring assembly. The assembly, one of the largest hydrostatic bearings ever made, will permit about 180-degree rotation of a 120-ft. mole radio-telescope antenna.

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The enlarged joint section at the right has a fatigue crack. It is almost invisible to the naked eye, even though an inch treatment has been used to make cracks easy to see. If the inspector doesn't spot this crack at overhaul, it will grow and become as dangerous as the one in the piston at the left.

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GENERAL ELECTRIC's Caravelle III powered by C3805-23C engines is equipped with thrust reversers. Engine cooling differs from that used by Caravelle on the 980 in that intake for this is shortened.

Aviation Week Pilot Report:

General Electric Aft-Fans Spur Caravelle

By William S. Reed

Edwards AFB, Calif.—Stalled-up performance for the Sud Aviation Caravelle through the installation of General Electric afterburners has given the twin jet transport the small field capability GE hopes will make it a leading contender in airline orders for the short-to-medium haul market.

Purchased from the Sud factory in Toulouse, France, last summer, the Caravelle "Saints Menu" has been flown more than 200 h: by GE test pilots. More than 100 h of this test were put on the aircraft before the C3805-23C afterburners were fitted to gather comparative data. Since the first flight last December, GE now has flown the remainder of the airborne time as an intensive test program which will provide data for certification of the production Caravelle VII by Sud.

A recent flight in the Caravelle led by Aviation Week showed the aircraft to have ample power reserves and very pleasant handling qualities in both normal and engine-out flying conditions and in power adequate small field landing and takeoff performance.

The Caravelle GE has modified with C3805-23C engines is a Mark III model and a one-of-a-kind item. Subsequent GE-powered Caravelles will be drag-nosed Mark VII and will differ con-

siderably from the aircraft GE is operating. The VII, now being constructed, will have a 2.2-ft extension in the fuselage ahead of the wing and will accommodate an extra row of seats.

The longer fuselage will permit an increase in gross weight and also will compensate for the extra weight of the longer aft-fan exhaust in the rear GE expects that GE expects to fit the Caravelle VII in mid-1967. And reportedly, will be able to deliver Caravelle VII's in the last quarter of 1966, thereby offering delivery a full year before Boeing expects to deliver its first 727 (AW May 6, p. 60).

Impractical Retrofitting

As to whether retrofit Caravelles could be modified to accept the larger engines, a GE engineer said he considered retrofitting with C3805-23C engines to be too expensive to make, the airplane practical. In addition to retooling the engines and tools, GE had to make engine mounting fixtures because of different attach points between the engines and the original Rolls-Royce Avon and a further aft engine center of gravity due to the shift in location of the rear fuselage had to be changed, motions to the bleed air ducts had to be made because the C3805-23C stage at which it is considerably better than the coming of the lower compressor exit to Avon, and an auxiliary

power unit was added to the tail to replace the electrical starting system used by the Rolls-Royce engines.

GE equips the aircraft with the same gross weight limitations pertaining to the Avon-powered models, i.e., gross max. gross takeoff weight is 101,400 lb., max. landing weight 90,570 lb. The Mark VII will have its takeoff gross increased to 113,240 lb. to 113,640 lb. and the landing weight increased to 108,172 lb.

A complete certification program would be necessary if the present aircraft were to be retrofitted to the higher weight and this is not necessary for the program GE intends to carry out which is to obtain engine and aircraft performance data for application to the Caravelle VII. On a continuous basis, data taken are transmitted to Sud for verification of the comparisons made on Caravelle VII performance.

Flight characteristics of the GE Caravelle III, N400CE, was tested by the Avon-Verne West pilot on a day when weather at takeoff consisted of strong gusts, surface winds gusting from the left, blowing wind, temperature 20°C (68°F), altitude 20 ft in the runway elevation 5,300 ft. Gross weight at takeoff was near maximum, 101,140 lb., and center of gravity was at 39.6% mean aerodynamic chord. Thrust/weight comparisons showed that V₁ speed was 115 kt. and V₂ speed was 125 kt.



TAKEOFF experimental results from a 40% increase in thrust allowed by the C3805-23C engines. Nacelles were built for GE by Hamilton

Performance

GE experimental test pilots R. J. Smith and L. V. Davis tested the Caravelle, was positioned on the Edwards runway, and checked the output of the two 16,000 lb.-thrust engines. The aircraft is not yet equipped with a device to provide direct measurement of thrust such as an exhaust pressure ratio (EPRI) gage because it is difficult to measure the output of the fan which supplies about 40% of the thrust.

The fan has a pressure ratio of 1.8, a 3.55 bypass ratio and admits a large volume of air at low pressure. Fuel throat can be moved, however, by changing engine rpm, fan rpm and fuel flow against manual valves. If the inlet guide vanes of the engine are closed (about the only abnormal condition which would limit thrust in flight) are half the fuel flow, this would be about one-half the normal value. This provides a positive measure of thrust in the single pool C3805 but would not be an accurate indication of power output in a twin pool engine.

Banks Release

At bank release, even though the Caravelle was at maximum gross weight, the acceleration was good. The aircraft was airborne at about 5,700 ft and an initial climb of 500 ft produced a rate of climb of 1,500 ft/min. At 100 ft/min then non-reversed to 140 kt. and the rate of climb, passing through 5,000 ft,



CLOSEUP shows engine pod housing the C3805-23C engine on the General Electric Caravelle. Fan has a bypass ratio of 3.54:1, pressure ratio of 1.8:1.

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RYAN X-13 VERTIJET
AND YE-SRY VERTIPLANE



HILLER X-18



VTOL

Chance Vought, Hiller and Ryan—three key names in the advancement of vertical flight—have joined forces to design a new "In-Service" VTOL transport aircraft for the Department of Defense.

These companies already have devoted millions of engineering man-hours to solving the design and test problems that will be vital in the development of the new transport. The complementing strengths and balance of the three-company team can be counted on to meet the challenge in the development of an operational VTOL prototype for the Army, Navy and Air Force.

Chance Vought's Aerodynamics Division—a veteran systems manager with an outstanding record in design innovation, weight control and expensive field service—has developed VTOL background in a high-speed turbine concept known as ADAM. Hiller, producer of light utility helicopters, pioneered the tilt-rotor VTOL concept and developed the Air Force X-18, world's largest V/STOL aircraft. Ryan's Aerospace Division designed and built the X-13 Vertijet—World's first jet VTOL—and pioneered the Ryan VE-SRY ducted stream Vertiplane.

Here, then, is an available "first team" with advanced experience and demonstrated accomplishment in the whole spectrum of VTOL—three strong records combined under the prime management of Chance Vought to provide the capability and experience required to put the new VTOL "In-Service" transport aircraft in the air by mid-1963.

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Deficiencies in these requirements can result in abnormal ring groove wear, cylinder barrel wear and scoring, high oil consumption, failure of the ring, and even the piston itself. This is something to remember if you are tempted to use a look-alike substitute.

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Caravelle VII Specifications

Engines	CFM56
Class	16,000 lb.
Over all Dimensions	
Span	102 ft. 6 in.
Length	185 ft. 4 in.
Height	28 ft. 7 in.
Area	1,775 sq ft.
Wingspan	30 deg.
Performance	
Max. speed	510 mph
Cruise altitude	31,000 ft.
Range with full payload	2,350 and up
Thrust	1,500 and up
Thrust/distance at max. take off weight	5,000 ft.
Lift/distance at max. weight	5,618 ft.
Wings-Max. Lift	70 percent
Max. takeoff	134,600 lb.
Max. landing	109,172 lb.
Payload—oper. loaded	15,120 lb.
Passenger & baggage	15,090 lb.

mean sea level 2 min after takeoff was 1,500 ft. with engine open at 90% (maximum continuous thrust) and low speed, which is equivalent, at 94% SFC, then reloaded the lift out to Avionics Wren and the climb was continued to 30,000 ft.

First secondary impression of the Caravelle is that the aircraft has a very solid feel. Afters and elevator response is positive and requires moderate force. Banking pull force appears somewhat high. Primary reason for the speed, a square and central force feel of the aircraft is its all-metal, monocoque control system. Control forces are, in fact, applied to the pilot through a system of boosters built on the ailerons and through an hydraulically operated artificial feel system with a "g" sensor on the rudder and elevator. Two complete and separate hydraulic systems designated "Blue System" and "Green System," supply power to the flight controls.

Each system has two pumps: one on each engine, plus the tailboom of a "Yellow System" powered by two electric motors. Banking this up is a "Red System," also electrically operated, which contains its own motor and a need for operation of landing gear flaps and wheel brakes.

Bypass features are incorporated in all ailerons and on the feel system to provide jamming of one system. Therefore, since one set of the four engine-driven and two electrically driven pumps will run the flight controls, and the systems are parallel and independent, complete failure of one system is highly improbable. In fact, with so many redundant features and with the system



RETURN is gained by an aircraft in a low SFC engine area. This is a Caravelle VII aircraft. This is a Caravelle VII aircraft. This is a Caravelle VII aircraft.

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DCS

color coding displayed on the pilot's overhead, causes no operation or failure on a variable impedance. Total result of the action is that control forces can be tailored to pilot requirements and ultimately send same to systems with their attendant problems are eliminated. Another requirement placed on the flight is that of repeated forced variables compared with other transport aircraft caused by having the windshield wick up of eight separate panels with wide vertical excursions as between Woodward is located far forward of pilot and is slanted at a 45 deg. angle reducing the vertical scanning area. This is standard with Convair and is an adaptation almost to that of the de Havilland Comet nose section. The forward cockpit, representative even more pronounced in most high speed aircraft. United Air Lines' Convair 440 has a cockpit designed for improved visibility. (AVN Mar 23, p. 15; Vol. 4, p. 53)

Mileage of 12,000 ft. was reached 17 min. after takeoff with the acceleration at 1,100 ft. of fuel from takeoff. Power was left at 90% and the warning bell warning that the landing gear was not down, sounded soon after leaving off. Speed at this time was 230 kts. IAS at an altitude of 12,000 ft., at about 121 mph.

Without reducing power on the right engine, the left one was shut down to check its position for proper condition. Van life rudder was required and a few minutes later, the warning bell warning that the landing gear was not down, sounded soon after leaving off. Speed at this time was 230 kts. IAS at an altitude of 12,000 ft., at about 121 mph.

C1805-23C Specifications

Engine type	Reciprocating
Application	General V-8
Stroke (in)	7.600
Rev. (rpm)	4725
Rated output (hp)	115 HP
Rated output (kW)	13.1
Rated output (kW)	17.0 kW
Rated output (kW)	20.0 kW
Rated output (kW)	21.0 kW
Rated output (kW)	22.0 kW
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SP-43 Flight Controller

SPERRY

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GENERAL ELECTRIC experienced test pilot L. W. "Doc" Davis (right) conducted a morning emergency on arrival performance with Avionics World's Wilbur Reed during flight in the C-47B several Cessna Aircraft, which took off at maximum gross weight, surging through 24,000 ft. at 1,000 rpm when plane was taken. Control panel and installation of a low EPR system were only modification GE made to the cockpit. Note use and placement of windshield panel.

speed stabilized at 210 kt. 145 ft. ascent was effected while at altitude from an engine rpm of 28.5% and a fuel speed of 180 ft. Minimum exhaust gas temperature (EGT) reached was 500°C during climb.

A clean configuration stall was encountered at 30,000 ft. with engine in idle. Buffet occurred at 115 kt., the stall broke through at 119 deg. angle of attack, together with a loud air flow stall change which produced force in the control yoke sufficient to cause 1.5 deg. nose down pitching moment. This force was incorporated manually and a stall occurred at 117 kt. at 18 deg. angle of attack.

Still we learned in other respect with almost control drops and no warnings displayed to drop either way. No push up trainers was indicated, it was down down after the stall.

Bulldog Margin

Level configuration stall produced much the same in landing qualities with the exception that the buffet began to rise again as gear. Buffet occurred at 104 kt., simultaneous with the sounding of the warning horn and the nose down turn change. Stall occurred at about 98 kt., slightly higher than it occurred at lower altitude.

Engineous data, which sometimes result in problems, are not a problem in the GE Cessna. Some aircraft with afterburned engines have been lost with stalls caused by detached flow into the duct which occur at high

power settings and high angles of attack. This is most critical at altitude but sometimes occurs in landing configuration. No stalls were experienced on the flight despite throttle bursts from idle to full power at 20,000 ft. in the climb and landing configurations. Davis reports that with this engine stall has been recorded in the program, this occurring at 17,500 ft. after the stall checks had worked. Even this incident resulted in a typical "hang" but did not cause the engine to quit.

When the landing configuration stall occurred, the engine was at 1800 rpm. From the right seat, viewed back, throttle full forward to dynamic pressure indication. Even in this critical condition, the engine reached full rpm in 7 sec. At the same time, the aircraft displayed very little yaw, indicating true change. The stall force was down then upward when gear from idle to full power while nose still was not moved because the thrust line of the engine is very near to the longitudinal axis of the aircraft.

Initially, each engine also is off-set 4 deg. inboard to overcome asymmetric thrust effects. Longitudinal thrust line location is offset enough so that the thrust line positive stability with power change. The longitudinal thrust arrangement also provides the additional advantage of not requiring an increase in forward stability area to overcome the destabilizing effects of a 40% increase in power.

Doesn't you find conventional loss



MCDONNELL

MAST-R-CHEK

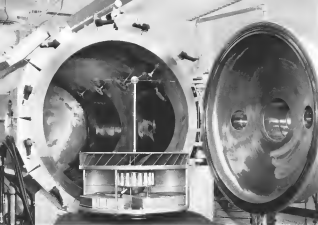
The McDonnell Mast-R-Check is a portable, pressure standard unit for safety ground testing aircraft and made air data systems to assure in-flight operations.

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- ✓ Mach system, altimeter, rate-of-climb indicators
- ✓ Engine pressure ratio indicators
- ✓ Cabin pressurization equipment
- ✓ Air speed indicator mechanisms
- ✓ Oxygen mask control equipment
- ✓ Mach warning switches
- ✓ Automatic pilot pressure sensors

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MCDONNELL



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BENDIX SYSTEMS DIVISION

ANN ARBOR, MICHIGAN



30,000 ft. back to the vicinity of Edwards with the intention of conducting low altitude landing and performance demonstrations. However, on approaching 10,000 ft., severe turbulence was encountered and it was decided to abandon this portion of the flight to avoid damage to the instrumentation and photographic installation in the aft cabin. Plans to conduct a series of 16.5 approaches at Edwards Airport and several landings at Edwards also was abandoned because of the weather which, in this case, consisted of reduced visibility due to blowing sand and a 40-knot crosswind component at 25 kt. Scouts elected to eliminate close to the ground demonstrations so they changed seats with Davis and the pilot retired to the observer's seat, being unwilling to attempt landing in unfavorable terrain with the prevailing weather.

Gross weight for the test was down to 93,500 lb. and Davis entered the downwind leg with speed below and 28 deg. of flap extended and averaged at 145 kt. Approach was made at 175 kt. with the climb showing $(V_{x_{max}})$ or over-the-horse speed at 121 kt. Even while approaching in turbulent air, with a strong, crosswind component, Davis demonstrated that ample lateral control is available with each slight flexion and movement of the wheel.

The Catalina settled onto the run way without power at approximately 100 kt. Thrusters actually were cut at about 100 ft. and a power-off descent made a successful and smooth approach in light crosswinds usually not so difficult with the C-47's 30-deg. croup.

Reverse thrust was not used, particularly because of coefficient drag and side cut at the time.

Flight time, at the completion of towing in the GE facilities, was 2 hr 15 min. Ground handling appeared easy with the side thrust of the engines supplying a moderate tow speed. At low gross weights, however, some power side bracing probably will be required because of the high scrubbed thrust of the aft fan engine.

Operating Bids Asked For Hydrofoil Craft

Washington-Martinez Administration has invited proposals for commercial operations of the 30-ton experimental catamaran hydrofoil craft under development by Dynamic Development, Inc.

Selection of the operator will be made on or before May 15. The 30-ft. craft will accommodate 70 to 80 passengers and have a speed of 60 knots. It will be used for testing in subsurface operations. Aerial Engineering Corp. owns 50% of Dynamic Development.

New Reduction Gear Box Being Developed

Robinson gear box integral with the propeller instead of the engine is being developed by Hamilton Standard Division, United Aircraft Corp., under contract to the U. S. Navy.

Substantial weight saving by elimination of duplicated bearings and other components has been predicted by designers, who see a 32% saving over a conventional installation for turboprop powerplants in the 2,500-3,000 shp class.

New gear box will discuss very low

basic change in either gear train or propeller design, and will utilize proven components in most areas.

The integral gear box was part of proposals made by the division to prospective bidders on the two-engine VTOL transport competition. The company believes that a propeller-gear box combination of this type would have particular value to V-510's.

They point out that the torque of the integral gear box, plus the variable number propeller (AV) Aug 15, 1960, a 90 possible incorporating glass fiber blades could develop into an extremely light and efficient propulsion package for VTOL designs.

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The Gallery-developed high temperature data in the new column may prove you with some new directions in your propellant systems design. Other data on performance is available covering density, density increments, heat capacity, solubility, surface tension, vapor pressure and viscosity vs. temperature. We are in for specific details on data and handling procedures for pentaborane.

Gallery Chemical Company, Defense Products Department

Headquarters: Gallery, Pennsylvania. Telephone Evans City (Pa.) 3510.
West Coast: 35537 Newark Street, Van Nuys, California. Telephone Btate 1 5261.

WHO'S WHERE

(Continued from page 21)

Changes

Paul B. Whitely, Special Director of United Aircraft Corp., East Hartford, Conn., has announced the following appointments: James D. Robinson, Jr., chief Western Field Engineering Department; Los Angeles Calif., supervising R. L. Collins, vice at F200; J. Louis Rosch and Development Center; Robert C. Smith, central chief, Western Field Engineering; Newton J. Stone, senior field engineer; South area; Randolph N. Wilbur, field design engineer.

J. Carl Moore, director of manufacturing, Aerogase, Rockwell Division of Bell Aerosystems Co., Buffalo, N. Y.

D. T. Bach, engineering manager, Dev-Tek Inc., Orlando, Fla.

Space Technology Laboratories Inc., Los Angeles, Calif., a subsidiary of Thompson Radio, Washington, Inc., announced the following appointments: Dr. James C. Bown, assistant program director for design; John Rogers, vice president; Robert F. Guilford, head, Information Systems; Communications Systems Department; Don N. Lawrence, manager of information technology; and William E. Feltz, project engineer for the Oshing Commanded Observation Platform Design Integration Department, El Segundo, California.

Dr. Charles L. Biederman, Washington, D. C., after serving for National Aeronautics and Space Administration.

Dr. Gerson Kain, corporate director of research, American Nuclear, Inc., Los Angeles, Calif.

Harold E. D. Oshing, manager, Product Development Department, National Bureau of Test Inc., Grand Rapids, Mich.

Dr. J. Robert Chernick, technical director of advanced development, Bell Laboratories, Murray Hill, N. J., and J. Louis Rosch, vice president, Bell Laboratories, Murray Hill, N. J.

Robert E. Oshing, manager, technical services, Division of Chemicals, Inc., Los Angeles, Calif., and Theodore G. Edm., vice president, technical services, Division of Chemicals, Inc., Los Angeles, Calif.

Robert E. Oshing, manager, technical services, Division of Chemicals, Inc., Los Angeles, Calif., and Theodore G. Edm., vice president, technical services, Division of Chemicals, Inc., Los Angeles, Calif.

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Robert E. Oshing, manager, technical services, Division of Chemicals, Inc., Los Angeles, Calif., and Theodore G. Edm., vice president, technical services, Division of Chemicals, Inc., Los Angeles, Calif.

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FRATE & WHITNEY J20 turbojet engine (57,000 lb thrust) is in S-1. Photo at right shows line and internal compressor section of J20 suspended in background; worker in foreground is inspecting the compressor section of a J20 (50,000 lb thrust) engine.

Airlines Gain Jet Overhaul Experience

More than three million hours of air line flight time accumulated by Pratt & Whitney Aircraft's four commercial turbojet powerplants have enabled it to solve engine problems that have defied flight or ground-level individual airplane inspectors, but no significant problems have developed to date.

Company engineers attribute that record largely to two factors: basic design philosophy of the engines, which do extend length and reliable components even at a weight penalty, and 2.7 million hours logged in military versions of the engines before commercial powerplants are entered airline service.

Foreign Object Damage

Recent survey of the engine program was that foreign object damage failed to interfere at a major share of available engine material. The trouble has plagued the airlines ever since this began jet operations: wrecks, glows, lightning, lunch bags and a host of other odd objects have been ingested and spit out again along with high-speed metal parts from the engines.

But the airlines—possibly through

their vigilance on the subject and containing collection of maintenance and ground personnel—have been almost trouble-free on this score. The main difficulties have been with fuel ingestion, which is the point where all the elements about has failed to pay off.

Civil Jet Powerplants

Most of the more than three million flight hours accumulated by Pratt & Whitney's current crop of civil jet powerplants is right about now. By the time the J20 (commercial version of the J7) and the J74 (commercial J75 engine), considerably less time has been built up on the J20, a lightened C-6 model, and only about 1,000 hr. credited to the J20-1 turbofan engine.

Each of these engines entered service with the airlines at 800 hr. time between overhauls (TRO). Current TRO value for the J20-1 is 1,500 hr., reduced 36 months after the engines started commercial service. The rate buildup is credited by both the J74, which has reached 1,500 hr., within 18 months after entering airline use,

and the J74-7, now at 1,200 hr. after only eight months.

With the high daily utilization of jet transports reported by the world's airlines, it is a relatively short time cycle for a typical engine between manufacture and first overhaul. Pratt & Whitney says about five months elapse between delivery of an engine and the time it leaves first overhaul. During that interval, the engine has screened, supported and satisfied the engine, ground run and flight checked it, used it for normal service life and pulled it for overhaul.

The overhauling company has done work, run the engine on a test stand and used it on the way again.

Overhaul costs vary across the industry, being dependent on wage rates and overhead among other factors. But Pratt & Whitney feels that the cost of swapped parts gives a fair estimate of the basic charge to the airline user.

Current price for J20-1 engine, most of which are now in their fourth overhaul and a few in their fifth, is from \$4,800 to \$5,400. Costs for the bigger J74 are higher—engines now going through their third overhaul are swap-



In the next decade, the United States is committed to an extensive program of space exploration. The Jet Propulsion Laboratory has been assigned, by the National Aeronautics and Space Administration, a responsibility for lunar, planetary and interplanetary unmanned exploration programs.

In the field of planetary exploration, the development and technology of automatic spacecraft and the gathering of scientific knowledge concerning the planets and their environment is involved.

By 1970, sufficient scientific data is to be acquired demonstrating the feasibility of spacecraft capable of orbiting and landing on Mars and Venus. In addition, programs will be initiated for probing Mercury and Jupiter and for further penetration into space.

The early Venus and Mars missions will utilize the Centaur launch vehicle and will constitute the "Manner" series. These will be followed by the "Voyager" series employing the Saturn system.

The vast amount of information to be acquired, the scientific research and testing necessary, the new concepts to be investigated and the number of areas to be explored constitute an extremely long range program. The challenge of probing the unknown, the vigor with which these problems are now being attacked and the demonstrated stability of the whole JPL operation provide career incentives for engineers and scientists in every field.

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JET PROPULSION LABORATORY
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Plan and design integrated scientific instrument test systems. Plan and direct system testing of scientific instruments in conjunction with the spacecraft system testing and environmental evaluation.

Perform design and analysis of structures for spacecraft and for future advanced projects in part or in whole. Responsibility for conducting structural tests during research and development period through final analysis portion of program.

Work with research engineers and scientists as support instrumentation for studies on materials for rocket motors, space vehicles and space experiments — scope includes crystalline metallurgy, high temperature stress strains, microstructure induction and resistance testing.

Perform advanced development on liquid propellant model engines and gas generators to be used in lunar and planetary spacecraft. Effort includes both in-house work and technical direction of outside contracts.

Participate in the design, testing and evaluation of solar cell panels development of laboratory sun simulators — also includes development and evaluation of solar thermoelectric and thermoelectric systems.

Organize and conduct experiments on the containment of high temperature plasmas for spacecraft power use in propulsion and for studies in thermoelectric physics.

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FAIR BLADE is weighed at left; at right a fan section is checked in a balancing machine at Pratt & Whitney Aircraft



only in the business not to rely on government sources for feedback, recognizing that time and money worked against complete coverage of difficulties in the military. Instead, the company relies heavily on reports of field service men and frequently is able to take corrective action before a formal case print is accepted.

Close consultation between engineering and field service is another factor which the company feels contributes to the commercial success of its engines. There is a group at field service charged with the responsibility of keeping engineering informed of problems in the field, directing the responsibilities of project engineers, who are responsible for all phases of the engine from design through successful operation. It is no secret at Pratt & Whitney that the

professional feature of a project engineer, especially in past times, on his ability to ride hard on the operational phase of an engine's life.

Actual maintenance savings, being tag together, avoidable engine field maintenance people and project engineers, is another approach to better operations of Pratt & Whitney engines. This is not unique to the company; many types of tracking has been standard among many segments of the powerplant industry and engine industry has noted that Pratt & Whitney feels that this engine approach, coupled with the other means of communication (test bed users, operators, designers, in which shape field service and maintenance technicians, gain the complete operational data on its products that it could get in no other way.

On the No. 4 bearing at the rear of the compressor, there was a hole in the oil seal. These oil seals with bearings, torques, problems. Two lines were made. Improved quality of engine gas, but mechanical to, and improved cooling of the bearing by changing the plate design completed this case.

The tachometer fans, plus the 114 engine case, loss in accuracy, and open without turning the tachometer shaft. This was fixed by tightening the connection.

A major factor in reporting and fixing engine trouble is Pratt & Whitney's unique representative field service organization operated by the company, which has long been noted and is a good by other, commercial outfits. With only a few field divisions, the group has a unique from Pratt & Whitney customer all over the world.

The department in the company's field service of representatives about 100 men enables Pratt & Whitney decide



Bell ACV Licensed for State Roads

Bell Autonomous Co.'s air cushion vehicle, first to be licensed for operation on state roads, is powered by a 60-hp. Porsche engine during a test mounted behind the driver and passengers. Bell's ACV weighs about one ton. Control system uses shock wheel and control cables. Operational height is about three inches off the surface.

A black and white photograph of the USSC-12, a large ship with two prominent antennas labeled 'VOR' and 'TACAN'. The ship is shown from a side profile, with various structures and equipment visible on its deck. A small boat is visible in the water in the foreground.

FAA Reports on Transatlantic Vortac Aids

the scope of the new patent's cover-

- VOM-bearing: 91% of the coverings against sealings are expected to have errors of less than 1 day

Emphasizing the value of the 20 home design awards, Harsco

is affected by a ship's rolling in rough seas.

at a distance of about 70 mm, we found the Vorticid streamer *Levinseniella* (a C-H flow at this altitude is powered by a bearing (lower) roughness of plus or minus 1 deg, until it is reached the first (lower) wall, when the bearing streamer increased to 2 deg to the height of the wall, i.e. a distance

AREA COVERAGE which could be provided used in combination with ultrasonic doppler is less than 5.6 square miles. Use of three acoustical transducers would increase coverage to 168 sq mi. or 330 sq mi. if a 1000 Hz transducer is used.

To reduce walk-in coverage and minimize corner roughness could be ship ruffing an ocean-Vortex could be mounted on a knee which would be jacked in the stern floor. Under 30 ft wave conditions the maximum roll angle of the knee would be about 6 deg, compared with 50 deg for an ocean station vessel. Anderson said. Twelve, the antennas could be located

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Pershing, the Army's newest, most advanced missile system, is being developed to provide artillery fire support to the Field Army. The unique tactical aspect of this missile is its exceptional battlefield mobility.

Pershing is mounted on a transporter-erector-launcher (TEL), an electromechanical system used to erect the missile into firing position, align it with the target area, and support it accurately until fired. The lightweight TEL system can be deployed by standard military aircraft, and/or helicopter and tracked carrier. The tactical prototypes of the TEL, which have been employed by the Army in all Pershing maneuvers to date, were designed and manufactured by the Tapco Group for The Martin Company, developers of Pershing.

Tapco's extensive experience in designing, developing and producing subsystems is one reason we are part of such programs as Pershing, and Advanced Tagger, Tagger, Nonconform, Bomarc, Bullseye, Silverdome and Polaris.

usage is employed and data can be sent off an elevated site, computer support. When received, on the ground, information can be fed into computer displayed on cockpit free field log or a cathode ray tube display. Computer reports that initial experiments show promise to be "highly successful" and that further work has been ordered by the Minister of Aviation.

► **Test Generator Stand**—Kathodion, Stamford, Conn., has received a Signal Corps contract to analyze all signal generators now used in Defense Department maintenance and overhaul facilities and make recommendations for modifications required to increase number and variety of such equipment required by military services. Contract is for \$10,000.

► **Lightweight Atomic Clock**—Development of an airborne atomic frequency standard, weighing only 624 lb., which is accurate to within one part in 10 billion and stable to within one part in 25 billion, has been developed by the National Co., Malden, Mass., for Wright Air Development Division. Device, employing a cesium beam resonator, is the smallest atomic clock developed to date. Early laboratory models, designed by National Co., weighed about 500 lb.

► **NES to Provide Loran-C Stand-**—In response to requests for a new means of evaluating the performance of aircraft instrument with and without



ALRI Antenna

Standards (24) probably entered use of last built for use with ANASCO-7 high-power data link for communicating with Airborne Long Range (ALRI) with enemy aircraft and linking their data into SACR system. Antenna was built by Galvco Electronics for Electronic Communications, Inc., which is building CAC-7 ground stations under Burroughs Corp. subcontract.



AT&T to Build Satellite Communication Antenna

Major satellite launch antenna, for use in communications satellite experiments, will be constructed by American Telephone & Telegraph Co. near Kailash, Mo. The antenna, a large version of antenna constructed by Bell Telephone Laboratories at Holmdel, N. J. for Project Echo communications satellite tests, will measure 377 ft. long and 94 ft. high. Antenna, which will be used both for transmission and reception, will be housed in an air inflated balloon, measuring 210 ft. wide and 161 ft. high. New AERTS balloon, which will cost \$7 million, is slated for operation early next year. The site in Maine was selected because it is surrounded by mountains which will minimize danger of interference with other military radio services. The horn shaped antenna configuration maintains satellite for greater signal intensity.

The National Bureau of Standards has

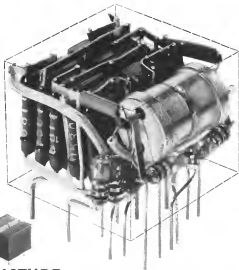
launched a program to provide lead alloy standards. These consist of a darkened glass and an electric lamp, together with a calibration report containing instructions for their use. Standards are available at prices ranging from \$45.00 to \$27.00 from the Plasmotron and Colortronics Section, National Bureau of Standards, Washington 25, D. C.

► **Signal on the Dotted Line**—Major contract awards announced recently by various manufacturers include:

- **Bell Telephone Co.**, Bellville, N. Y., will build 17 AN-SPN-10 automatic landing system for installation aboard 10 Navy aircraft carriers and at two land bases for training only. First installation will be aboard the nuclear powered USS Bataan. Contract value will exceed \$10 million, company says.
- **Magnavox Corp.**, Ft. Worth, Ind., Navy contract for \$10.5 million for production of an airborne warfare radio receiver for use on PTW and PTW ASW aircraft.
- **Servotek, Inc.**, Alexandria, Va., will manufacture computer developed automatic track-hold system for use by

surface-to-air radar under Navy Bureau of Ships contract.

- **Stratronics Corporation**, Santa Monica, Calif., \$125,000 award from Martin Marietta for space-ground gear to be used in trainer networks.
- **Block Systems Co.**, Huntington, N. Y., \$1 million award from Bureau of Naval Weapons for pilot production of computer developed AN-ASN-10 tracked ASW display and computer control for Grumman S2F-1. System displays radar data from automatic detection equipment, showing target location, as well as basic data including weapon information.
- **Colfax Radio Co.**, Cedar Rapids, Iowa, \$1.3 million contract for production of AGS-2-A horizontal stratum induction for Air Force target business Computer. Also reports \$574,000 contract from USAF for HF-101 airborne single channel HF communications transmitter and receiver.
- **American Electronics, Inc.**, Los Angeles, \$614,000 in contracts, most of which cover automatic regulated motor generator sets for use at Westcotts KCBM land site and mobile aircraft vehicle trailers for support at Westcotts and Titan land sites.



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and loss of 14 db maximum. Isolation for "F" band is now under development. For additional application data, write manufacturer: Federal Research Group, Inc., Atlanta & Minneapolis Div., 4 Union Square, Somerville, Mass.

• Semiconductor trimming potentiometer, Model 356, for printed circuit

board use has high off-the-board dimensions of only 0.195 in. and requires 1 cu. space. Resistance is available in increments of 10 ohms to 50,000 ohms for operation over temperature range of -55°C to 200°C , with power rating of 1 watt up to 50°C , derating to zero at 200°C is still in. Resistance at 50,000 ohms is 0.085%, according to manufacturer: Davidson Inc., Potentiometer Div., Avondale, Penna.

• Resistor, wirewound, ultra-precision, available power unit rated at one watt, resistance 1 in. maximum diameter, 9 3/16 in. maximum length. Presumably these resistors are being made to order in 1% tolerance, 1 to 6,000 ohm range. Additional information in Bulletin 147 available from the manufacturer.



ture, Glushko Mfg. Co., 1657 Howard St., Dallas, Tex.



• Underwater transducer will operate at water pressures up to 60 psi. and over a frequency range from 10 cps to 50 kHz. Below resonance, response is constant -82 db reference 1 volt per inch. Transducer is inherently non-directional over normal frequency range and can be used as a transmitter or as a receiver. With 66 ft. of cable the transducer weighs 11 lb. when using brass tubing to drive piezoelectric disks for converting sound to electrical energy. With aluminum piston the transducer weighs 9 lb. Manufacturer: Clevite Division of Clevite Corp., 906 East 105 St., Cleveland.



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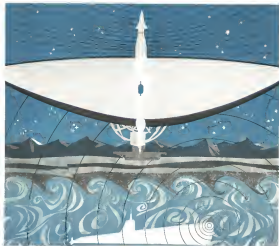
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EQUIPMENT

Jet Advent Stresses Ground Handling Lag

By Barry Todd

New York—Major airlines, drawing on over two years of experience, are striving to reduce ground handling operations in order to complement the flight speed increases without increasing costs.

Both domestic and international carriers at New York International Airport, many of which are in operation, have announced, are concentrating their efforts to improve jet on time, departure percentages and to reduce such as faster turnarounds, more in fast baggage. The new terminals, with their greatly increased ramp space, serve to aid ground handling in this respect although several carriers are already planning gate expansion.

Carriers say that only about 1% of departures are late due to poor performance on the part of ground handling crews and equipment. The average late percentage is much higher than this and comes considerably lower month to month and airline to airline.

Primary cause is maintenance breakdown of which a leading offender is inadequate tools. Another factor at fault is that of jets being held at the gate by ground control due to traffic jams at the taxiway system.

Despite good intentions and a general effort at expansion, there is considerable room for improvement. Current systems, while satisfactory during normal scheduled operations, break down when an out of sequence flight arrives simultaneously.

Le Gardein Report

Reports to Le Gardein Airport are among modest examples of the shortcoming. A sudden land that an aircraft can produce a command to depart at La Guardia sufficient to cause all arriving propeller traffic to be diverted to Idlewild. This causes peak traffic loads which normally are the heaviest of the domestic airlines at Idlewild, resulting in delays in the taxiing public infrastructure flight conditions also now cause several jet transports to be delayed on a typical weekday morning.

The latest scheduled turnaround time for an aircraft at Idlewild is about 1 hr. Most jet operations can depart at least 15 min which cut the amount of fuel burned, the second time usually results which an airport crew attach a clear (lightly loaded) aircraft. Fast turnarounds are significant in terms of aircraft utilization, however, from the

passenger viewpoint, the important thing is the carrier's ability to adhere to the published schedule.

Another problem which appears a long way from solution is the chaotic change of service vehicles which approach the arriving jet from all points of the compass. This waste of men and ground equipment is particularly apparent during periods of peak traffic loads.

Due to this is a more extensive use of bodied facilities. In this respect Idlewild lags behind other world airports. The Port of New York Authority reports that negotiations with the airlines are incomplete and no schedule is set for its proposed pipeline fuel delivery system.

Such a system from Idlewild fuel as has planning outlined others await the availability of the fuel.

Ramp Fix

United, American and Pan Am complete jets at ramps to speed, eliminate power to jet transport. This serves to reduce time traffic as does the baggage transfer system. A direct air conditioning system is operating at Ft. Worth's Addison County Airport eliminates another service vehicle.

The cost of installing any of these systems is vast, decentralized Idlewild (with its high water table) is staggering, and leads in the upcoming era the professional airlines will conduct the

confusion and disorder were dramatic reason to increase ground handling efficiency.

Widening, providing direct access from loading gates to the aircraft, are coming from throughout the national jet airports. These jets also eliminate the need for passenger ramps and provide protection for passengers from precipitation, cold and high winds.

Loading the jets is usually accomplished by two fuel trucks which can complete the job in less than 20 min. Experience has produced close coordination between fuel suppliers and the airlines and the fuel usually is available on time.

The most time-consuming chore in loading a jet turnaround is clearing the passenger compartment—occupying about 30 min each hour. Various aircraft designs play an important part here. Factors such as early cleared air services can facilitate the performance of a clearing crew. The use of Yellow rubber footwear type speed replacing solid hard cover on seats and over-coat-covered nylon bags are helpful.

The various methods of loading passenger baggage at different terminals is a complex matter individually. Container systems, conveyor and mechanical passenger aircraft tend to appear to complete fairly quickly. Factors, one of the larger carriers still loading jets be hard from baggage



Multi-Carrier Idlewild Terminal Planned

New terminal being built at Idlewild International Airport, New York, for Northeast Airlines, Northwest Orient Airlines and Revell International Airways is scheduled for early 1963 completion. Terminal will cost an estimated \$10 million, passengers will enter and leave the structure through open air corridors protected by movable awnings.

What is the proper mix of Manned vs. Unmanned Satellites?



opportunities for systems analysts

Hughes Aerospace Engineering Division has openings for Systems Analysts to consider and analyze a wide spectrum of basic problems such as:

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We promise you a reply within one week.

HUGHES

AEROSPACE ENGINEERING DIVISION

larity, is in the good grace of the user: rapporteur customer-like government it does permit the affiliate to retain its national identity.

"As a policy, we don't like to buy a majority holding," one spokesman said. "We want enough so that we can place our man on the board and have a say in the management, but we don't want to become the funder that the company is a national firm, a name we're hiding behind. That's their biggest advantage—they can get into places where no American firm can go."

Another admitted that such investments are "calculated risks." There are a lot of "ifs" in any of these deals, but we think we have to expand to keep ahead of the game, and that is the way we think we should do it."

The "calculated risk," he added "can also be paid in terms of dollar and cents. Sometimes there's not much more involved than an exchange of KIB's."

The straight-line connection with the United States has its advantages and disadvantages, according to an official whose company has looked toward the establishment of subsidiaries.

"Sometimes it can work for you, it gives the customer a feeling of reliability in the product. However, in dealing with the government, it can work against you. If we go in with a

product and a German firm goes in with ours that's almost as good, he's going to get the contract."

In this particular case, the U.S. firm has given serious thought to wanting its subsidiaries work on established German companies, if it can find one that meets its requirements and is willing, in hopes of offsetting the disadvantages which it sees in numerous circumstances.

Initial capital outlays for a manufacturing subsidiary are relatively large, but, when the profits begin to arrive there is no spinning to be done. A subsidiary also, of course, presents greater control.

U. S. Techniques

United States production techniques, management and sales approaches can be introduced with a minimum of difficulty. Production sites and distribution can be carefully geared to keep pace with the demands of the market.

New products can be introduced at substantially with a minimum of red tape. The same applies to problems developed by the subsidiary that the parent firm wants to produce and market in the U. S. or elsewhere.

The subsidiary also can—and sometimes does—become a licensee for production made by a domestic competitor of the parent company.

As U. S. firms move in various ways to insure that future in the European market, the rising technology of Europe is making itself increasingly felt in the U. S.

Business and technology competition flows. Europe threatens to present a major challenge to individual U.S. markets, particularly in the light of its extensive field. Transport design and powerplants already have made their move. And, in efforts to diversify, close a competitive gap or simply buy a competitive idea, U.S. firms are manufacturing a number of European products under license ranging in size from gyro to complete aircraft systems.

Recent agreements include the following:

- France's Turbomeca, license rights in Continental Airlines & Engineering Corp. for the installation of small gas turbines.
- Holland's Fokker, production and marketing rights in Fairchild Engine & Airplane Corp. for the CT-77 turboprop transport. Fokker's built more than 50 of the aircraft thus far, according to Fokker.
- France's Nord Aviation, production rights to Bell Aerospace Co. for the C-741 and CT-75 major cargo aircraft.
- France's Sud Aviation, production and marketing rights in Douglas Air-

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PROBLEMATICAL RECREATIONS 64



For $N < 1$ evaluate the infinite product: $(1 + X + X^2 + \dots + X^N) (1 + X^2 + X^4 + \dots + X^{2N}) (1 + X^4 + X^8 + \dots + X^{4N}) \dots$

— Mathematics Magazine

The number of products from our Potentiometer Division is large, but finite. Talk to them about linear pots, function pots, hand compensated pots, and pots with special mechanical configurations. Direct all inquiries to Potentiometer Division, Mt. Vernon, New York.

ANOTHER TO LAST WEEK'S PROBLEM: A shows that B and C are marked. A reasons that if he also is marked, B and C will each see two marked foreheads and all heads will stay raised. If, however, A is unmarked, B and C will each see one marked and one unmarked forehead. His hand will be raised only because he sees a mark on C, and vice versa. Very shortly either B or C will recognize this same pattern, deduce that he is marked, and put down his hand. A allows enough time for B or C to come to this conclusion, and since neither does, A knows that he also must be marked.

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If you'd like that **RIGHT AT HOME** feeling in your work and family living, write immediately in complete confidence to Mr. Marvin Rabin, Dept. C-51, Boeing Airplane Company, Wichita 1, Kansas. Equal job opportunities for all qualified applicants.



WIVES

Wichita is a progressive family community—often called "The Gateway to the Great Southwest." It is a city of beautiful homes, broad streets, modern shopping centers and excellent schools. Kansas is in the heart of America, where you will enjoy sunshine and fresh air the year around. You are just a day's drive from the mountains and streams of Colorado or a few hours from the Ozarks of Missouri. And regardless of where you live in Wichita, your husband is just a few minutes drive from Boeing.

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PROPULSION PROJECT ENGINEERS

Twice EW has several openings for project engineers in its rocket engine component development program. These programs are devoted to the design and development of components and systems for advanced solid fuel engines.

As a project engineer you will be required to supervise the efforts of several development engineers, conduct tests and handle customer participation in staffing decisions, help to prepare proposals and generally coordinate your own program through to its successful completion.

We feel that this is an excellent opportunity for the right engineer. If your experience includes stress analysis, heat transfer, or mechanical design on rocket engines or other propulsion systems you may be the one we are seeking. Qualified engineers are invited to write or contact R. J. Eberhart, Professional Staffing Manager, ERM 165, at the address below.

TAPCO GROUP

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AVIATION WEEK, May 1, 1962

$$0 = \frac{dx}{dt}^2 + \frac{x}{r^3} + \frac{\partial R}{\partial x}$$

$$0 = \frac{dy}{dt}^2 + \frac{y}{r^3} + \frac{\partial R}{\partial y}$$

$$0 = \frac{dz}{dt}^2 + \frac{z}{r^3} + \frac{\partial R}{\partial z}$$

PLOTTING PATHWAYS IN SPACE

A special group of engineering-oriented mathematicians (and mathematician-oriented engineers) at DSD is exclusively concerned with both theoretical and practical sides of astrodynamics and orbital mechanics. Space probes, man-craft vehicles, lunar satellites and missiles—all fall within their range of interests. In addition, the statistical problems of data interpretation and mathematical techniques of vehicle guidance are under investigation.

The group operates in an informal, friendly atmosphere. Staff members enjoy direct access to the best computer equipment available—including an IBM 7090, a 300 magnetic analog computer, a complete telemetry station, and the finest microwave instrumentation in the free world (MILTRAM).

Although many contracts are in progress, strong employment is the norm in a wide latitude of independent investigations. One of the results of this policy was the creation of **GENERAL ELECTRIC Electronic System Division**.

You are cordially invited to look into the fascinating opportunities in our expanding astrodynamics group—so, if you are an experienced electronics engineer interested in broad systems assignments, we'll be glad to discuss career openings in several other equally challenging program areas at DSD.



Write informally, or forward your resume to
Mr. R. A. Smith, Box 178.

DSD DEFENSE SYSTEMS DIVISION
A Division of the General Electric Co.

GENERAL ELECTRIC

Western Office Building, Syracuse, New York



Combat Surveillance Problems Have Ballooned Since 1861

Airborne surveillance of enemy armor was inaugurated with balloons shortly after Washington from which the Union Army watched Confederate movements. But the airborne surveillance techniques of the Civil War have long since yielded to progressively more sophisticated sensor technology.

Tomonaga's approach to the problem of conflict surveillance is a dynamic part of the research effort of the Cornell Aeronautical Laboratory. Her research is being conducted, on the requestment of surveillance, defense and concepts of advanced super-luminal systems as being conducted.

Thus, 1st order of our current development progress designed to exploit the advanced state of the art require staff additions covering all of the scientific disciplines. If you are considered in becoming a member of one of our small, closely knit research teams, take the first step now. Send for our 50 page report, "A Commission of Science."

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Abstract

2004

Journal of Management Inquiry 20(4) 409-424

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Though many kinds of fish as well as dolphins have been operating successful detection systems (electronic and acoustical) long before Homo sapiens arrived on the scene, WHOED engineers today have increased the original inventory of such unknown devices

Tide range: Where *G. ovata* and *T. trawcei* must be soaked with range maintainers in fact, NMED engineers think in terms of (classified) miles. Right now they are exposed to crashing the AN/SQS-78 Search Sonar System to hunt out widely larger predators than your worried fish or porpoise—elephants with metal fins, distances thousands of feet, routine at the ocean.

Orbital frequency Where *T. truncatus* operates at high frequency (in which case he can still reach humans a dog or two) HMEC engineers, recognizing the problems imposed by high frequency

recognition of repeated signals in water, are now developing low frequency systems that would make a dolphin flip.

Opportunities are now open for engineers to join RMED on the AM/92B-26 program, as follows on versions of the RMED developed sonar systems that successfully detected ice conditions for USS Nautilus on its latest under-the-North Pole voyage, on a new underwater system that will enable man to monitor surveillance on millions of cubic miles of water space; on other projects in line coast underwater detection.

Additional openings exist in the fields of: Marine Guidance and Control, Air Traffic Control, Data Processing & Display, Ground Station/Plant and much more...10,000 sq. sq. ft. plant size. Marine Radios

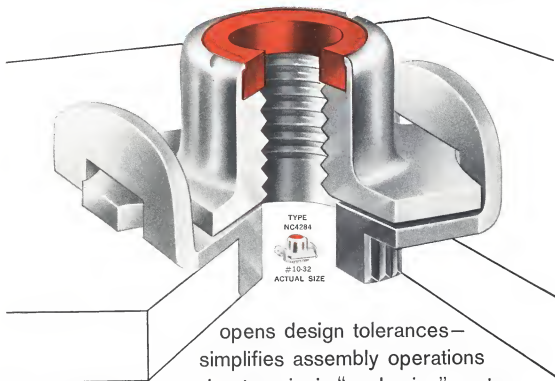
Engineers with experience in any of these areas are in
in full confidence to Mr. G. Colander, Div. 64 W-3



HEAVY MILITARY ELECTRONICS DEPT. **GENERAL ELECTRIC** COURT STREET, SYRACUSE, NEW YORK

AVIATION WEEK, May 8, 1961

NEW MINIATURIZED "FLOATING" CLINCH NUT



Standard ESNA Non-floating Clinch Nut Types

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350°F



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Here at last is a reduced-dimension clinch nut and basket assembly that provides .020" minimum radial float. Because the nut is able to compensate for minor bolt hole misalignment in the component to be attached, production line techniques can be simpler and faster.

This very lightweight type NC4284 nut offers the electromechanical engineer new design opportunities in the assembly of electronic chassis, panels, cover plates and many other "packaging" applications. Due to its very narrow basket this fastener requires less flange width for installation than any other similar-purpose press or stake-in type part.

The retaining basket has a precisely knurled shank which standard ESNA punch and dolly tools firmly embed into aluminum or mild steel sheets, for maximum security against twist-out or push-out forces. The new fastener is easily installed in a drilled or punched hole using a regular drill or arbor press.

ESNA's exclusive red nylon locking insert gives this nut a consistent locking torque through more than 50 on/off cycles. It guarantees reliable fastener performance for assemblies that demand frequent disassembly for maintenance or inspection needs. Yet the smooth grip of the nylon collar will not flake cadmium plating from the bolts. The special formula nylon accepts temperature environments from -65°F. to 350°F.

This new floating clinch nut is designed in both carbon steel and 303 FM stainless—in sizes No. 4, 6, 8, and 10. Each thread size is available in 2 shank lengths of .040" and .060" for flush installation in sheets of equivalent or greater thicknesses.

For complete specifications and installation instructions on new part NC4284 and many other lightweight avionic fasteners, write Dept. S58-525 for a copy of the new Aerospace Catalog No. 960.

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